Micro-Mainframe Connectivity

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Vic Wheatman
AUTHOR

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DATE LOANED	BORROWER'S NAME
2/5/86	J McDaniel

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I INTRODUCTION

A. BACKGROUND

- The micro-mainframe (M-M) issue consistently scores high in INPUT's client polls. In 1985 interest continued to climb assisted by a barrage of vendor announcements which have made it difficult to identify and understand key issues and to determine which, if any, micro-mainframe path to take.

- The potential impact of M-M linkages on the corporate communications network is difficult to determine, and many users direct little attention to this issue.

- The growing proliferation of corporate-based microcomputers is fueling end-user demand for access to large company computers, and there is growing appreciation of the productivity made possible by this connection. However, the potential problems these linkages can cause are only beginning to be recognized and understood.

- INPUT believes M-M is the first logical step in distributing mainframe information to end users and, as such, becomes more than a question of, for example, terminal emulation or screen versus file transfer.

  - The additional issues emerging involve the impact of increased micro-mainframe applications on communications facilities, ease-of-use, security, and maintaining central data base concurrency.

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- Timing issues need to be addressed. Should M-M be implemented now or should information systems (IS) wait for new products?

- This study generally assumes that the micro-mainframe world is an IBM or compatible world.

  - INPUT acknowledges that the assumption remains somewhat debatable. For example, Apple's plans to place the Macintosh in corporate America, AT&T's continuing computer efforts, and other vendor participation may provide a basis for corporate M-M strategies. Two key points need to be made:

    . IBM's current interconnect strategy provides an underlying environment for IS.

    . Equally important are the views held by IS. The non-IBM compatible share of corporate micros is expected by IS management to be very low compared to IBM and compatibles, as shown in Exhibit I-1.

  - This does not mean there is no place for innovative micro hardware in Fortune 1000 corporations, but from the M-M standpoint, such devices must generally be transparent to IBM networks for easy use and acceptance.

B. METHODOLOGY

- The report research was conducted in parallel with that for four other related reports (see Section D below). The research consisted of:

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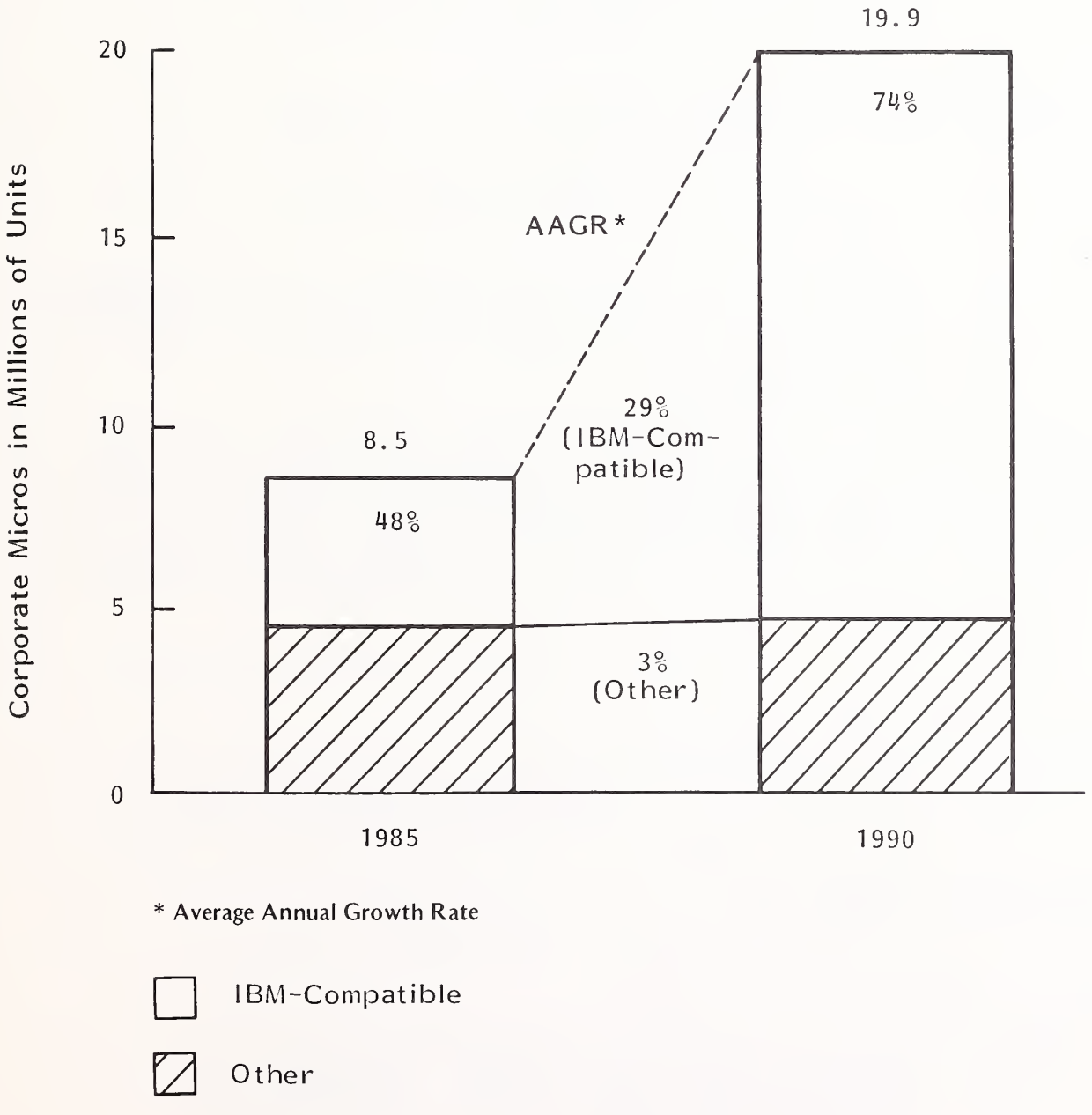
EXHIBIT I-1

CORPORATE MICRO GROWTH, 1985-1990



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- Client interviews.

  . INPUT clients were sampled to determine areas of special interest and to learn of their experiences, problems, and needs.

- Corporate interviews.

  . Approximately 130 structured interviews were conducted with IS managers at large corporations in March 1985.

    - The questionnaire used is in Appendix A.

    - Company sizes and industries are shown in Appendix C.

  . In addition, INPUT had the opportunity to review 20 companies in depth, with the information used to inform our analysis and recommendations.

  . In the past two years, INPUT has conducted a number of consulting studies bearing on M-M issues. While no proprietary information is revealed, the knowledge gained is represented here.

- Vendor interviews.

  . Structured interviews were conducted with vendor personnel from 25 companies. The questionnaire used is located in Appendix B.

- Product and service analysis.

  . INPUT collected and analyzed information on over 100 M-M products and services.

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. The continuing change represented by new products means that this report risks obsolescence upon publication. Some announced products may never be brought to market. Product introductions will continue, with offerings expected from LAN vendors and various software companies.

. Vendors are even promoting modems and communications software as M-M products, causing further confusion over just what micro-mainframe really is.

. Nevertheless, the issues discussed here remain valid despite the dynamic forces at work in the industry.

C. SCOPE

- This report, produced by INPUT's Telecommunications Planning Program, is one of a series of continuing studies analyzing micro-mainframe; it is designed to help understanding of the communications issues which can arise as M-M is approached and implemented.

- It addresses the following topics:

  - The current status of micro-mainframe and related telecommunications technologies (Chapter III).

  - Telecommunications capacity and component growth planning methods for micro-mainframe implementations (Chapter IV).

  - The functions which remain to be addressed by vendors (including IBM) and anticipated market trends and technological developments important to M-M connectivity planning (Chapter V).

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- Recommendations for implementation and building relationships between IS, telecommunications, and corporate management to generate a fuller understanding of the issues, capabilities, and limitations of M-M applications (Chapter VI).

- The questionnaires used in researching this report are contained in the Appendices.

D. RELATED REPORTS

- Interested readers are referred to the following INPUT reports:

  - Micro-Mainframe: End-User Experiences (1985) describes various M-M methods, their advantages and limitations, suggests implementation strategies, and projects changes in the technology and marketplace.

  - Micro-Mainframe: Software (1985) categorizes the M-M software products necessary to accommodate M-M access with special attention on security and data integrity requirements. The report recommends a software development/acquisition strategy.

  - Micro-Mainframe: Corporate Impact (1985) describes the organizational and technological effects of M-M in the corporation in light of the growing demand of end-user access to corporate data bases. The impact of M-M products on the current inventory of standalone micro and mainframe software is also analyzed.

  - Micro-Mainframe Market Analysis (1985) segments the market and provides projections for terminal emulation and intelligent packages, and analyzes issues, events, and trends in the marketplace.

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- These reports update a similar series published by INPUT in 1984:

  - End-User Micro-Mainframe Needs examines end-user experiences through case studies, forecasting future product directions and the major technological and planning issues identified, with recommendations focusing on the technical aspects of micro-mainframe.

  - Personal Computer to Mainframe Market Opportunities (1984) addresses and analyzes micro-mainframe developments and the impact they will have on the microcomputer industry. Includes discussion of the changing applications environment, market directions and needs, competitive environment, customer requirements for vendor support, market forecasts, and strategic recommendations.

  - Micro-Mainframe Processing Services and Turnkey System Market Opportunities (1984) addresses opportunities and challenges faced by processing services and integrated systems vendors, analyzing the threats these suppliers face from microcomputers.

  - Micro-Mainframe: Telecommunications (1984) addresses the telecommunications components of micro-mainframe.

- Other relevant studies are:

  - Destiny of the Information Center (IC) (1985) examines the impact of the microcomputer and end-user computing on the future of the IC.

  - Integrating Voice and Data Communications (1985) analyzes the changing technologies of telecommunications, the benefits and costs of integration, the evolution of LAN, CBX and other devices and provides guidelines to when data-only networks are most appropriate.

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- LAN/CBX Trends: Decision Processes for Users (1984) describes current and future product trends and presents a planning process for managers to ensure successful implementation of a strategy meeting corporate needs.

- LAN/CBX: Planning for Change (1985) reports current experiences with these data and data/voice communications technologies and looks at the future of office-oriented communications devices.

- Office Videotex (1985) examines corporate, in-house applications for this user-friendly technology which has so far failed to make an impact as a new consumer-oriented media.

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II EXECUTIVE SUMMARY

- This Executive Summary is designed in presentation format to help the reader quickly review key research findings and recommendations. It will also provide an executive presentation, complete with script, to facilitate group communications.

- The key points of the entire report are summarized in Exhibits II-1 through II-5. On the left-hand page facing each exhibit is a script explaining that exhibit's contents.

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A. MICRO-MAINFRAME IS IN TRANSITION

- Micro-mainframe (M-M) technologies are in a period of transition between simple terminal emulation and integrated intelligent links offering sophisticated, customized capabilities to both end users and IS.

- The ideal, universal solution allows microcomputer users to easily locate, format, convert, and manipulate mainframe data stored on any machine accessible through the corporate network.

- This ideal is several years from full actualization. In the interim, demands for M-M continue to be heard and available products may adequately serve.

- M-M is also in a transitionary period between implementations responding to end-user demands motivated by desires to improve personal productivity and management recognition that M-M can be an important tool used company-wide to meet information management needs.

- This transitionary period provides an opportunity to evaluate M-M requirements and anticipate the impact M-M and other applications will have on the corporate network.

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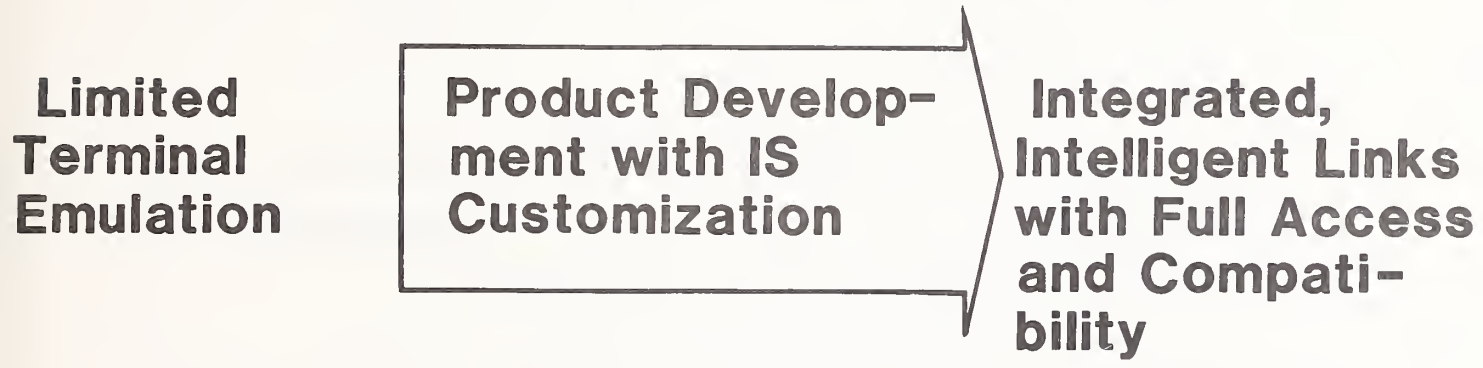
MICRO-MAINFRAME IS IN TRANSITION


Limited Terminal Emulation
Product Development with IS Customization
Integrated, Intelligent Links with Full Access and Compatibility

NOW IS THE TIME TO EVALUATE NEEDS AND NETWORK IMPACT!

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B. COMPLEX COMMUNICATIONS FORCES AFFECT MICRO-MAINFRAME

- There are three principal micro-mainframe link types:

  - Terminal emulation using plug-in boards which essentially convert micros to dumb terminals and generally allow only mainframe data viewing. Local processing is not possible during emulation and generally the links operate at low speed.

  - File transfer which downloads entire mainframe files requiring large storage capacity on the micro and customized programming on both ends of the link. These also operate at low speeds.

  - Advanced, intelligent links which integrate with mainframe applications, extract specified data, allow uploading of revised information, and operate at higher speeds.

- Link considerations involve software, protocols, cabling, local area networks, packet switching, intermediate processors, protocol converters, gateways, modems, servers, data switches, CBXs, interfaces, and other communications equipment.

- Because M-M is still evolving, there is the danger that currently available methods will become obsolete. New technologies also cause uncertainty and confusion. Meanwhile, pressure to implement continues to mount. IS needs to develop skills in forecasting to help it minimize implementation of rapidly outdated solutions.

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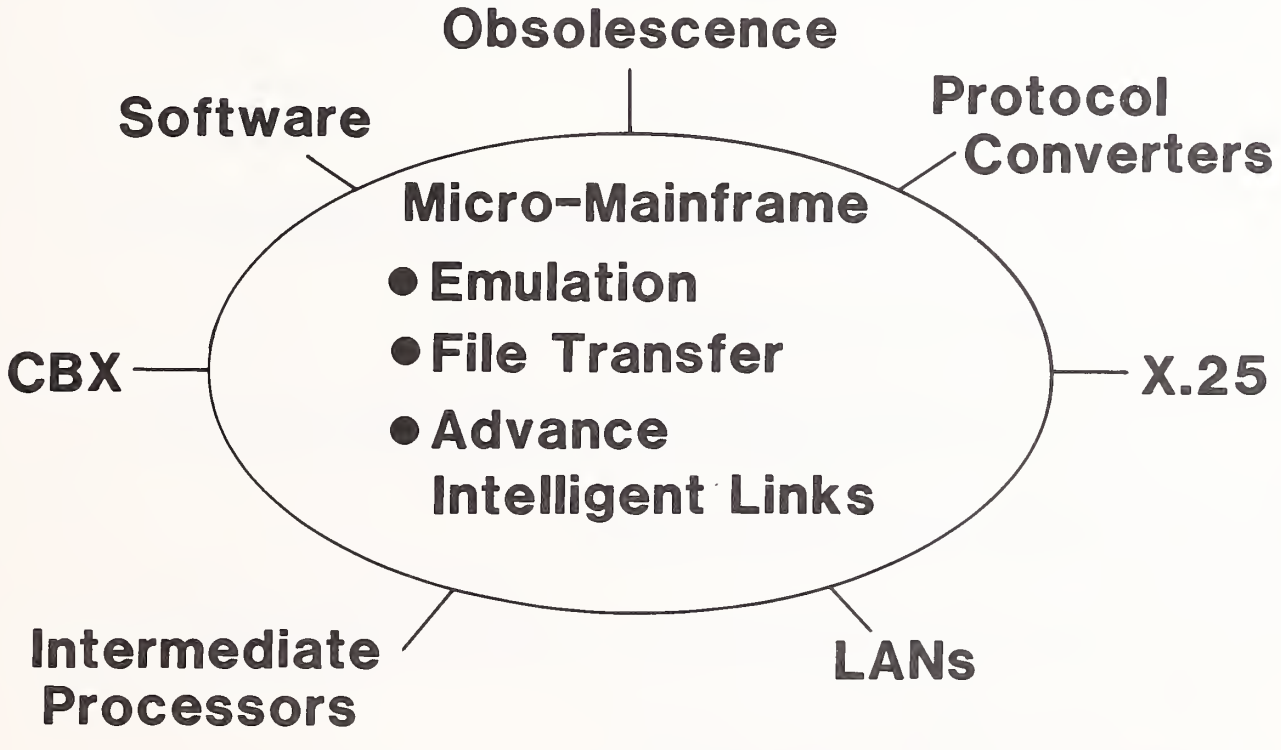
COMPLEX COMMUNICATIONS FORCES AFFECT M-M



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C. COMMUNICATIONS PLANNING IS ESSENTIAL

- The dynamic telecommunications environment, coupled with M-M issues, complicates the telecommunications manager's corporate network planning.

- IS evaluation of micro-mainframe communications impact is often an afterthought. Such planning is complex, but M-M, along with other factors increasing demands on corporate networks, requires planning for future capacity.

- The recommended planning steps are:

  - Determine current capacity.
  - Analyze response times needed.
  - Project future network needs.
  - Evaluate hardware requirements.
  - Implement operational steps to manage network resources.
  - Control costs wherever possible.

- A corporate commitment to capacity planning is important. In addition to anticipating communications growth, such planning provides valuable information for vendor negotiations.

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COMMUNICATIONS PLANNING IS ESSENTIAL

- Determine Current and Future Capacity Requirements
- Evaluate Hardware Needs
- Implement Operational Rules
- Control Costs
- Obtain Corporate Planning Commitment

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D. HIDDEN COMMUNICATIONS COSTS ARE DIFFICULT TO JUSTIFY

- Without planning the impact of micro-mainframe on the corporate network, the true costs of implementation are unclear. These costs are often overlooked.

- Pricing the communications pieces of the M-M puzzle is a difficult process. In addition to software, the products required range from cables to controllers, to processors and beyond to packet or satellite networks. There are also associated network management and installation costs.

- M-M communications cost determination cannot be done in a vacuum. It is a part of the entire network system and the costs are imbedded in overall corporate network expenses. This makes isolating the costs attributed to M-M difficult.

- Implementation costs should be stated in terms of costs per user, permitting analysis based on the value of each worker's effort and providing a basis for charging costs to end users.

- Justifying M-M communications costs can often be based on unquantified productivity enhancements and through recognition of the network as an asset rather than a cost center which does little to enhance corporate profits.

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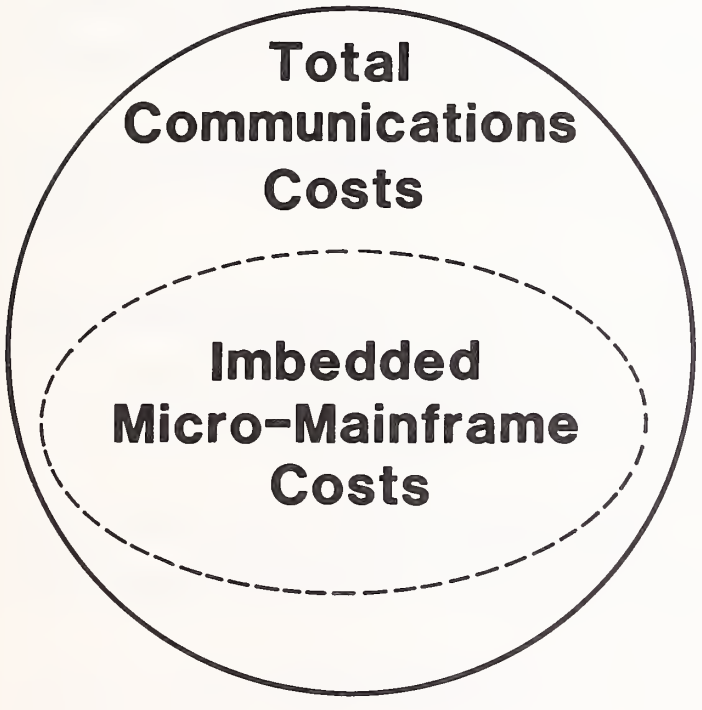
HIDDEN COMMUNICATIONS COSTS ARE DIFFICULT TO JUSTIFY



To Justify:

- State Costs Per User
- Justify Based on Productivity
- Recognize Network as Corporate Asset

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E. ANTICIPATE COMMUNICATIONS NEEDS

- IS should initiate low-risk micro-mainframe projects as a learning tool and proceed on fuller implementation in carefully planned stages. This staged development strategy provides valuable information helping IS plan future network requirements.

- IS needs to understand corporate and departmental goals, motives, and problems and recognize that responding to current end-user demands for M-M is reactive. Managing corporate information requires more proactive planning to improve communications throughout the organization.

- IS also needs to anticipate telecommunications technology developments which may improve company information processes.

- M-M initiatives may accelerate IS decentralization due to distributed information management. If unplanned, this can negatively impact organizational effectiveness. Decentralization issues should be forthrightly addressed rather than consciously or unconsciously obstructed.

- Because of technical implementation risks, IS should join with vendors to find solutions.

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ANTICIPATE COMMUNICATIONS NEEDS

NEED	ACTION
Telecommunications Planning Information	Use Low Risk Projects
Improved Communications	Initiate Proactive Planning
New Solutions	Monitor Telecommunication Technical Developments
Distributed Information Management	Consider Decentralization
Improved Chance of Success	Experiment with Vendors

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III CURRENT MICRO-MAINFRAME ENVIRONMENTS AND TRENDS

- Based on INPUT's interviews and analysis, INPUT concludes that micro-mainframe links are still in a transitionary stage between simple terminal emulation and evolving, intelligent links offering sophisticated capabilities to both end users and IS.

- Understanding the current status of the technology and anticipating future technologies (further discussed in Chapter V) is central to informed planning.

A. TYPES OF MICRO-MAINFRAME LINKAGES

- One of the problems which surface with M-M (or any complex topic) is recognizing the gradients of the technology--the levels at which it operates, its capabilities, limits and physical pieces.

1. LEVELS OF CONNECTIVITY

- Conceptionally, M-M connectivity ranges from manual entry of data to fully interactive, real time programs, as shown in Exhibit III-1. This hierarchy also represents the evolutionary path of the technology. The goal of shared functionality implies reaching the range of 4-5 shown on the exhibit.

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EXHIBIT III-1

HIERARCHY OF MICRO-MAINFRAME CONNECTIVITY

5. Integrated, Intelligent Applications Programs (Coordinated Processing Between Mainframe and Micro) Using the Virtual Floppy Method
   - Batch and Interactive

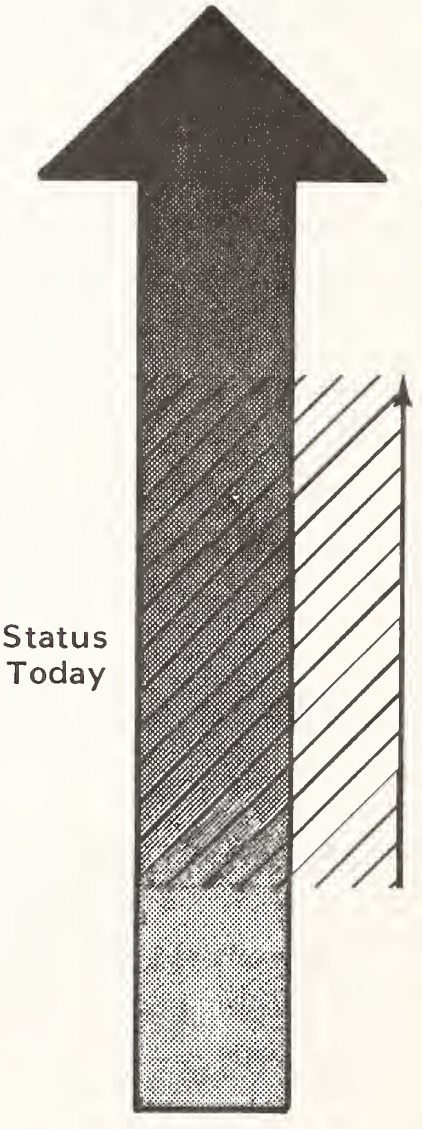
4. Logical Data Bases Covering
   - Multiple Hardware and Software Environments

3. File Exchanges (Bidirectional)
   - Low or High Speed, Proprietary or Generalized Structure

2. Downloading - Low Speed
   - Extracts and Operational Files

1. Manual
   - New and Rekeyed Data

Key: Darker Shades Indicate More Complex Issues/Unresolved Implementations



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- There are three basic methods of micro-mainframe linkage:

  - Terminal emulation is a low cost method using plug-in boards or software to allow microcomputers to be used on-line by appearing as terminals to the mainframe.

  - Terminal emulation with data transfer adds the ability to upload and download information, usually a file or a screen at a time, but sometimes selective data is extracted. This requires knowledge of mainframe commands, and files may not be in the most usable formats, or may be too large for micro storage.

  - Intelligent links integrate with mainframe applicaton programs such as query and report writers, and often create central storage areas which appear to micros as floppy disks.

    . Information can be selectively located using micro-based commands which are automatically translated into commands recognized by the mainframe.

    . Data can be manipulated in spreadsheets, data base, word processing, graphics, or integrated programs, and then uploaded to mainframe or intermediate files as revised.

- Products can be "general," designed to allow micro access to a variety of common mainframe file structures, (called "open architecture" by vendors) or "proprietary," working only with certain mainframe software.

- Some proprietary products will only download into specific vendor software or a limited number of popular packages such as VisiCalc, Lotus 1-2-3, or dBASE II.

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- The characteristics, benefits and limits of these types of linkages are shown in Exhibit III-2.

- Truly universal links, supporting a wide variety of both micro and mainframe software, are not yet available. This is causing IS delay in implementing since there is understandable reluctance to be locked into specific software on either end of the M-M link, and since there is a tendency to wait for needed applications rather than accept limited products.

- INPUT's report Micro-Mainframe Software Issues offers a more detailed look at the levels of M-M linkage.

2. THE PHYSICAL LINKS

- The physical linkages may include plug-in boards, controllers, twisted pair, coaxial cable, local area networks, or intermediate processors serving as file servers, protocol converters, multiplexers, modems or line drivers, data switches, or CBX equipment and, at each end, the appropriate interfaces (i.e., RS-232C or coaxial interfaces).

- Further, internetwork devices called gateways serve to connect two or more networks for wide-area communications. Gateways typically provide protocol translation and message buffering to accomodate speed differences between networks.

- Micros operating in terminal emulation modes are usually connected to the host through coaxial cables. If, however, emulated terminals have synchronous protocols, the link requires a clocking signal. Not all micro-based plug-in boards with terminal emulation provide this timing function.

- Limited Distance Modems (LDMs), also called modem eliminators or line drivers, can be used for short-distances between micros and mainframes, using existing twisted pair.

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EXHIBIT III-2

TYPES OF MICRO-MAINFRAME LINKAGES

LINK TYPE	CHARACTERISTICS	BENEFITS	LIMITATIONS
Terminal Emulation	Modems and Plug-in Boards.	Micros Connect to Mainframe, Extending Utility.	Micro Becomes Dumb Terminal. Only Views Data. Local Processing not Possible During Emulation.
File Transfer	Mainframe Files Bulk Transferred to Micro.	Mainframe Data can be Used by Micro.	Customized Programming Required on Both Mainframe and Micro. Slow, as Only Entire Files Are Downloaded. Requires Large Micro Storage Capacity.
Intelligent Links	Integrate with Mainframe Applications. Central Storage Areas Often Appear as Floppies to Users.	Data Extracts from Several Files Available for Integration into Micro Applications. Can Sometimes Upload Revised Files to Mainframe. Higher Speed Access by Micro.	Only Accesses Specific Applications or File Structure.

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- Exhibit III-3 shows the variety of telecommunications links and the physical pieces in the M-M relationship, which are discussed later in this report.

3. USER CONFIGURATION NEEDS AND EXTERNAL COMMUNICATIONS

- Respondents were asked to rate the importance of linking their company's micros to their corporate mainframe, to more than one type of mainframe, to micros in other departments, to mainframes in other companies, and to micros outside the company.

- Further, they were asked to indicate the types of communications linkages which would be used for these various situations.

- Exhibit III-4 shows the findings of the survey.

- In the 1985 survey, the importance of micro-to-corporate-mainframe links was rated 3.5, with 5 being of highest importance. However, in 1984, the ranking was 4.2. INPUT feels this reduction reflects the current M-M evaluation period.

  - In 1984, IS was feeling significant end-user pressures to implement M-M, and the rating reflects a heightened sensitivity.

  - In 1985, there is growing recognition that these demands are symptomatic of the problem of making information available to those who need it.

- M-M is currently implemented in response to end-user demands, thereby improving personal productivity. What is emerging is a corporate view and planning to implement M-M elsewhere in the corporation to benefit corporate-wide information management needs.

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EXHIBIT III-3

A VARIETY OF LINKAGES ARE POSSIBLE

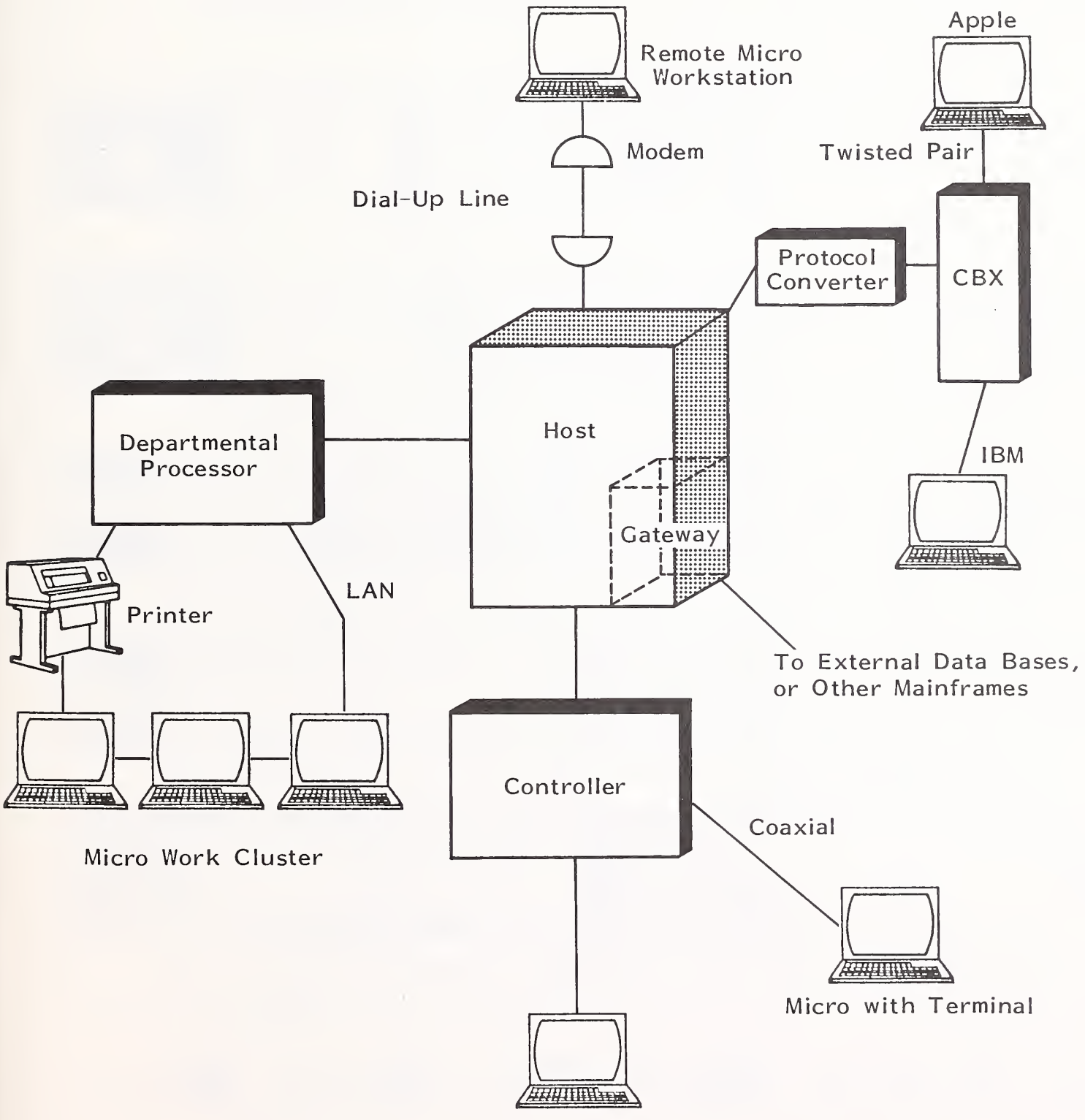

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EXHIBIT III-4

USER CONFIGURATIONS AND EXTERNAL COMMUNICATIONS

CONFIGURATION	RATING*	LINKAGE MODE RESPONDENT PERCENTAGES
Micro-to-Company Mainframe	3.5	20.6% | 30.5% | 1.3% | 23.0% | 2.2% | 22.4%
Same Micro-to-Multiple Brand Mainframes	2.1	17.2% | 30.5% | 26.5% | 2% | 22.5%
Micro-to-Micro, Same Company	2.6	44.4% | 19.2% | 2% | 20.3% | 1% | 13.1%
Micro-to Another Company's Mainframe	2.0	6.8% | 20.2% | 2.2% | 56.2% | 1.2% | 13.4%
Micro to Another Company's Micros	1.5	8.6% | 14.8% | 3.7% | 54.4% | 3.7% | 14.8%

LAN | Leased Line | WATS | Dial | Data Net | Other†

*Average Rating, with 5 Being "Highest Importance".

†Other = Direct Links, through Controller, etc.

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- The ratings given for other configurations are consistent between the 1984 and 1985 surveys.

- From the telecommunications viewpoint, it is not surprising to find that LANs, leased lines, dial-up access, and direct links are those most favored for micro-mainframe connections.

- LANs are favored for micro-micro links, and dial-up access is the most favored method to connect a company's micros to another company's mainframe or micros.

- WATS lines and public data networks received very low ratings, suggesting:

  - Internal linkages are unsuitable for WATS or public data networks.

  - The specific connections (e.g., connecting micros to another company's micros) will be infrequent, negating any cost benefits.

- The survey findings understandably indicate that the need to communicate outside the corporate environment (i.e., to public data bases as well as other corporations) was seen as less important than communicating internally. The low rating reflects a lower priority for these applications, as well as a lack of experience or imagination.

  - Public data base vendors, such as Dow Jones News and Information Service and statistical data bases such as Duns Plus, that cater to corporate micro users have great success, with new subscribers being added in significant numbers daily.

  - Publically available electronic mail services, such as MCI Mail and the soon to be announced AT&T Mail, provide services quite valuable to users.

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- Micro-mainframe applications of these types, which go beyond corporate facilities, need to be considered in planning M-M access methods and their impact on corporate communications.

4. SECURITY ISSUES

- Security and data integrity issues were rated as the most critical problem created by M-M.

  - Twenty-nine percent rated security as the primary problem and almost 12% placed the issue second.

  - Data integrity was placed first by nearly 8% of the respondents, and 14% placed it second.

- Security issues surface at three levels: backing-up data, preventing unauthorized access, and maintaining the "purity" of the central data base. This later concern surfaces when users are given the capability to upload revised data to the mainframe.

- There is little unique about M-M security except that with more users, there are more opportunities for security breaches.

  - Mainframe-based security measures can be established just like they are for terminals, with passwords or authorization levels permitting access and updating of certain files or fields within files and audit trails.

  - Central storage can be protected by using extract or intermediate files permitting the accuracy of information to be verified before being passed to the central data base.

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- Dial-up mainframe access can be further secured with encryption and with call-back procedures.

  . A call-back system is programmed to recognize an authorized user by an identification code. When remote terminals or micros are used consistently from the same telephone or extension number, call-back ensures that only users at those authorized numbers gain access.

  . The Data Encryption Standard (DES) uses a mathematical algorithm to scramble data. Encrypted data is input to the same algorithm using the same key for restoration.

  . Both types of protection are available in a new device combining terminal authentication with data encryption.

- Security problems are further analyzed in INPUT's 1985 reports Micro-Mainframe: End User Experiences, Micro-Mainframe: Corporate Impact and will be addressed in a telecommunications security report, scheduled for publication later in the year.

B. THE SHARED FUNCTIONALITY CONCEPT

- INPUT coined the term "shared functionality" to describe a key characteristic of M-M applications. Shared functionality is the sharing of processing and data between mainframe and micro.

- Seventy-four percent of the respondents felt that within five years personal computers linked to the host will take over a considerable amount of functionality now currently host-based.

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- The findings were consistent with the fact that a majority of the respondents were able to report planning or implementation of M-M applications. Although many might be called primitive in that the provide only for terminal emulation, they do represent experiences which are paving the way for further development.

C. DECENTRALIZATION

- Shared functionality implies decentralization which, in turn, has ramifications for corporate communications networks which must serve dispersed users.

- Respondents were asked to rate the impact of micro-to-mainframe applications on moving their company toward decentralized information system functions.

  - With one representing "no impact" of M-M on decentralization and five representing "great impact," respondents averaged nearly a three rating.

  - This compares with an average rating describing current decentralization status of slightly over two.

  - The shift toward decentralization caused by M-M is shown in Exhibit III-5.

- These findings are significant in that a company's movement toward IS decentralization impacts the very structure of IS and its reporting roles in the organization, and also impacts the design and use of corporate networks.

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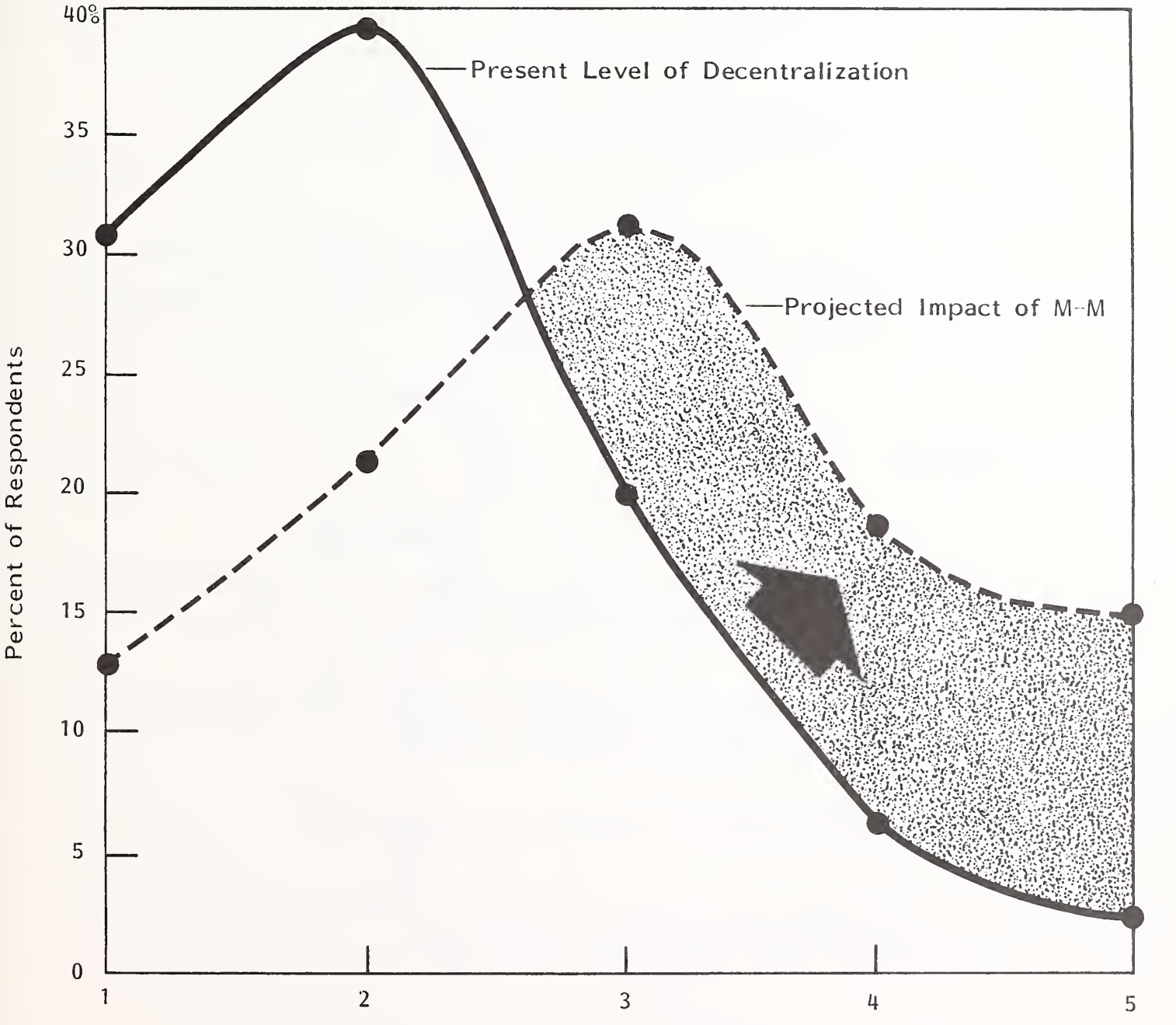
EXHIBIT III-5

M-M IS SHIFTING I.S. TOWARD DECENTRALIZATION



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D. APPLICATIONS

- INPUT's survey asked IS departments to identify the applications seen as most suitable for micro-to-mainframe.

- The leading responses were accounting, financial analysis and management, decision support, inventory and purchasing applications, office automation, sales and marketing statistical analysis, and personnel applications such as payroll.

- Exhibit III-6 shows the relative frequency of responses.

- Evaluating end-user applications is an important factor in determining the sources of additional traffic impacting the communications network and to provide guidance on network configuration.

E. CAPACITY

- Users interviewed think M-M applications will increase main CPU processing loads by an average of 17%, but this may not be what actually occurs.

  - Twenty-eight percent of the sample expect increases averaging 10-15% and 32% see a 20-30% increase as a result of M-M.

  - Thirty-two percent see little or no increase.

  - The general view is that micros do not offload processing from the mainframe, but indeed require increasing capacity.

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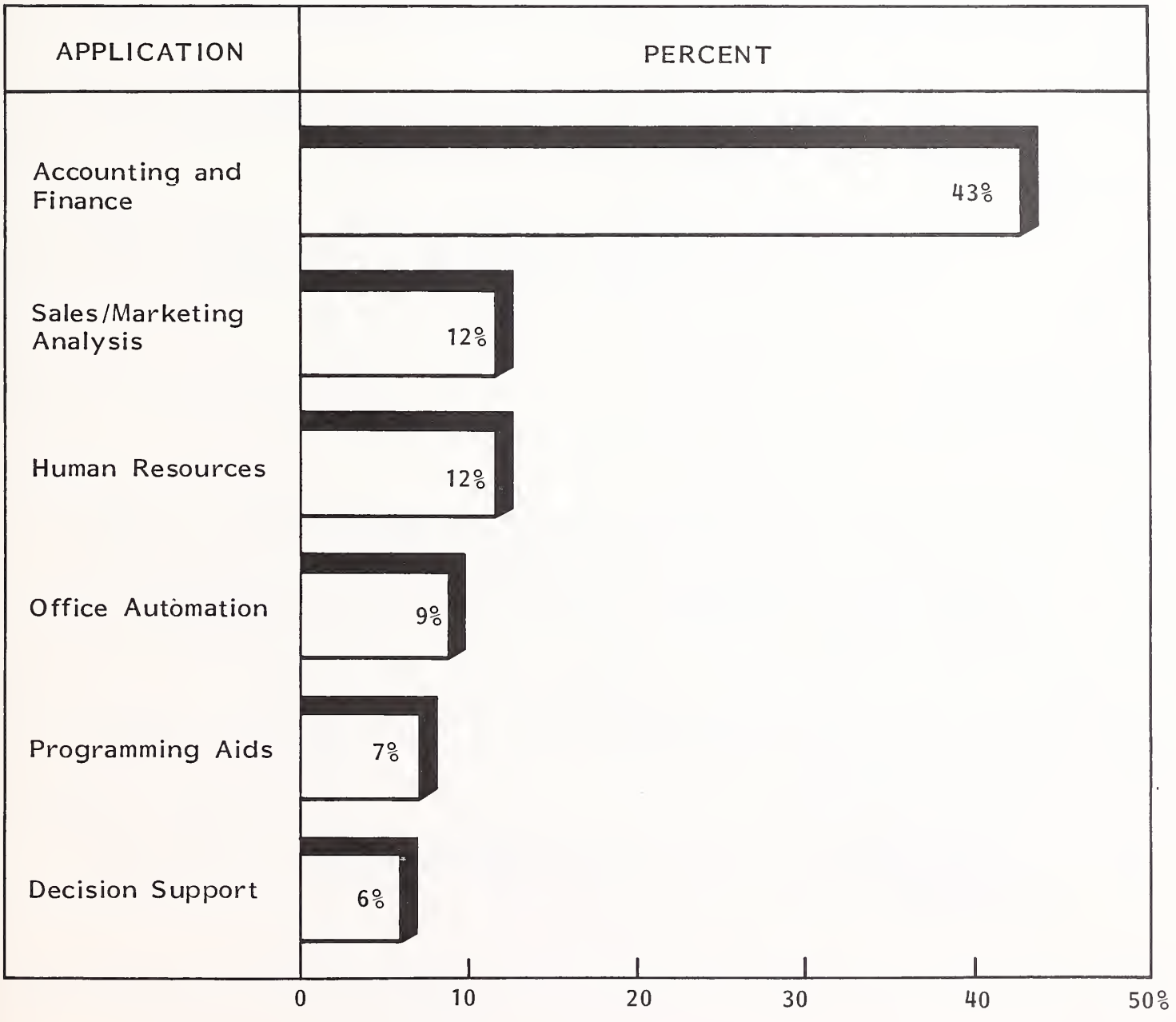
EXHIBIT III-6

MICRO-MAINFRAME APPLICATIONS
(Percent of Respondent Mentions)



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- This projected increase also means increasing need for network capacity to handle added communications.

- A company's central computer communications capacity may need to be increased with the addition of new CPU or communications controller ports due to M-M demands.

- Predicting end-user's needs is difficult. M-M largely consists of file transfers.

  - Structuring the time and nature of these transfers may be required to accommodate currently limited network capacity.

  - The alternative is random transactions using these resources, causing response time deterioration and denied access to other users.

F. STORAGE

- Users surveyed expect microcomputer usage to increase mainframe storage requirements by an average of 18% by 1987. Thirty-two percent projected a 10-15% increase and 22% saw a 20-30% increase. However, 38% projected little or no increase.

- Exhibit III-7 shows how users see M-M creating demands for additional computer resources.

- Methods of planning for future communications requirements are discussed in Chapter IV.

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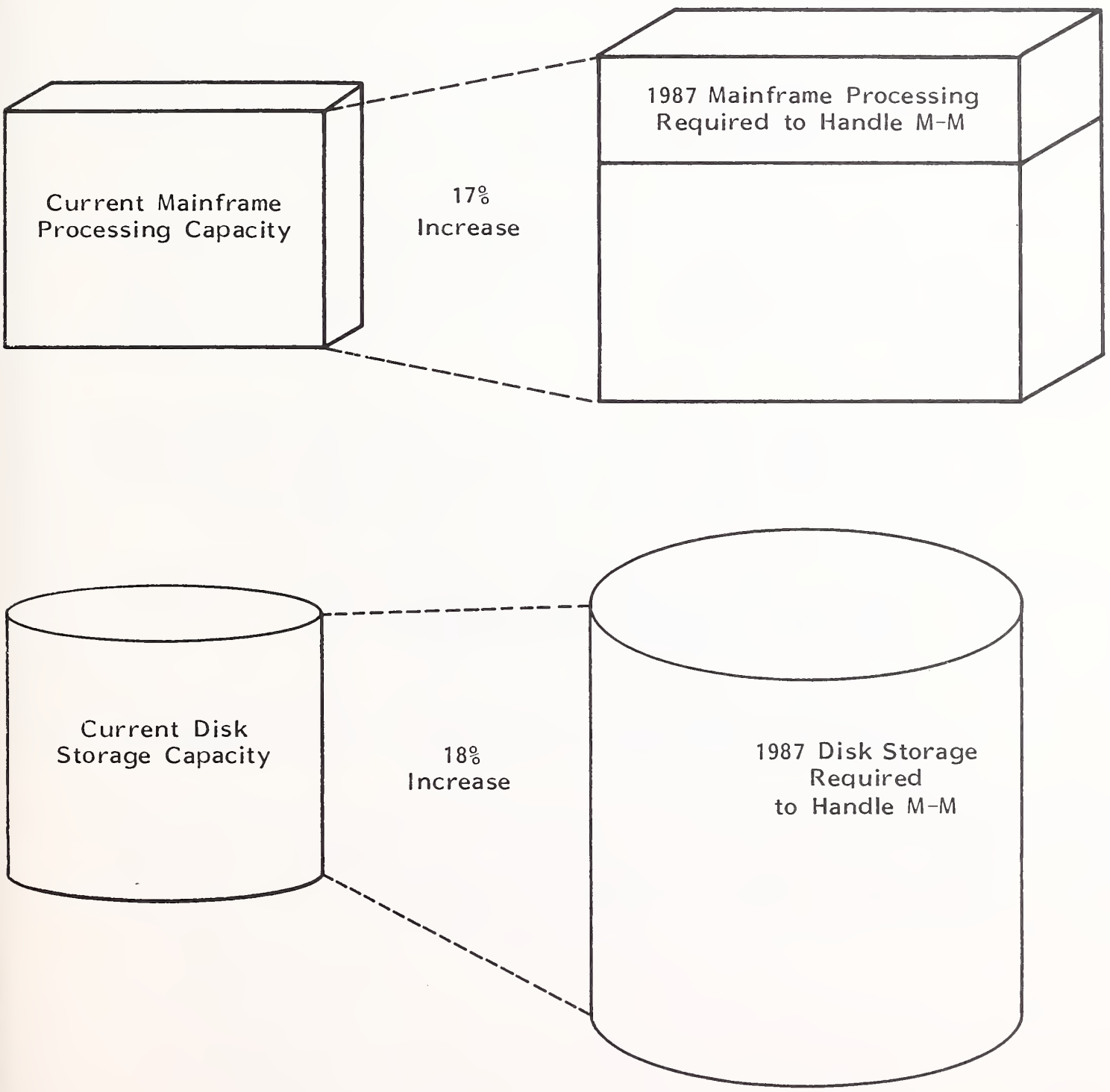
EXHIBIT III-7

AVERAGE PROJECTED IMPACT OF M-M APPLICATIONS
ON MAINFRAME PROCESSING AND DISK STORAGE DEMANDS


Current Mainframe Processing Capacity
17% Increase
1987 Mainframe Processing Required to Handle M-M
Current Disk Storage Capacity
18% Increase
1987 Disk Storage Required to Handle M-M

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G. MICRO-MAINFRAME COMMUNICATIONS PROTOCOLS

- Currently, M-M is largely confined to low speed, asynchronous, and synchronous protocols.

- As Exhibit III-8 presents, there are advantages and disadvantages to these forms of communications.

- Asynchronous, bisynchronous, or SNA (Systems Network Architecture) protocols are all suitable for M-M, and there is no agreement on which standard is best. Many available M-M products support all three.

- For dial-up asynch communications, protocols emulating 2740 devices are often used to communicate to the host through asynch modems. This offers fairly reliable transmission and can incorporate limited error checking routines.

  - While this can be a low cost method, using existing wiring and relatively inexpensive modems, this factor must be balanced against the low speeds (1,200 bits per second or under) typically supported.

  - With the introduction of faster modems (as described in Chapter V, Section D) this limitation is being overcome.

  - Slow speeds are suitable for the occasional user where low cost is more important than high speed.

- Bisynch and SNA protocols require hardware and software on the micro which allow connection through coaxial cable to a 3274 controller. In this case, micros generally emulate the 3270 class of terminals.

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EXHIBIT III-8

ASYNCHRONOUS VERSUS SYNCHRONOUS COMMUNICATION

Communications	Benefits	Limitations
Asynchronous	• Universal Applicability • Cheap • Good for Low Volume, Noncritical Data	• Slow • Poor Error Checking/ Recovery • Micro Serves as Terminal • Port per Device Needed
Synchronous	• Direct Hookup to 3270s (if Bisync) • Fast • Good Error Checking • Relatively High Volumes of Data	• Bisync is Device-Dependent and Requires Coaxial Cable • SNA Complexity • IBM- (or Other Vendor) Dependent • Expensive

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- This type of M-M operates at much higher speeds (up to 2.5 megabits per second) than asynch. This alone can justify the higher costs of required coaxial or twinaxial cabling and installation.

- This is also advantageous because networks will support the terminals being emulated, thus facilitating connections.

- Further, micros serve double duty as terminals, capable of functioning on a standalone basis with local applications. This obviates the need to have both terminals and micros competing for valuable desk space, a situation existing in many companies.

    . A key disadvantage is the need to install coaxial cable for the physical linkage.

    . RS-232C runs are limited to 50 feet, although extended distance cable can be used up to 250 feet.

- Fault diagnostics in bisynch communications are generally poor, and adequate transmission capacity is often not available at reasonable rates for interbuilding and intracity communications.

    . This situation is changing (see Chapter V, Section I on expected intra-LATA packet switching and conversion services from regional Bell operating companies).

    . Bisync is also vendor hardware and architecture dependent and, as such, can be relatively expensive.

- Installation of broadband and fiber optic networks will remove many of the communications bottlenecks affecting M-M systems. If LANs are widely used for M-M, standardization in LAN architectures and protocols will ease this problem.

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- Clearly, no one solution is universally suitable. If specific users need M-M links only occasionally, then slower speeds and less expensive equipment is appropriate. For intensive M-M sessions, production systems, and certain classes of applications (such as highly responsive on-line telemarketing or graphics), faster speeds are desirable.

- A more detailed discussion of protocols can be found in INPUT's 1984 report Telecommunications Interfaces for the Mid-1980s.

H. LANs

- One approach to implementing M-M links is to use local area networks (LANs) which bind micro resources and peripherals in work groups and also work to link micros through gateways with host computers.

- One method involves using a micro on the LAN to act as a communications controller which ties synchronously through a modem to the mainframe. Other micros use the first to access the mainframe by emulating remote terminals.

- Another method for micro-to-mainframe linkages relies on LAN gateway intelligence residing in the LAN server to store the communications parameters for each connected device, automatically setting up the necessary conversions to complete the link.

  - LAN servers handle linkage and conversion tasks.

  - Such translations can slow communications, and not all conversions are available.

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- Exhibit III-9 shows these methods of connecting LANs to mainframes.

- INPUT asked respondents to quantify the number of LANs currently installed, and planned to be installed by 1987, and how many of these LANs do, and will, link to mainframes or minicomputers.

  - These findings are related to installed micros in Exhibit III-10.

  - As an aggregate, respondents project a seven-fold increase in the number of LANs which will link to mainframes or minis.

- LANs will increasingly be used for M-M linkages, as well as to share data and peripherals in work groups. Vendors are starting to take the M-M tack in their marketing efforts. Technological improvements driven by Very Large Scale Integrated (VLSI) technology will add flexibility to LANs while lowering prices.

- Other LAN developments are discussed in Chapter V.

I. INTERFACES

- Connecting micros to LANs, such as Ethernet, requires Ethernet attachments and other coax connections require compatible interfaces. These are less common on micros than standard RS-232C connections (although some vendors incorporate these interfaces in their products, i.e., the IBM 3270 PC and 370 PC). For this reason, plug-in boards are used to support these connections.

- Federal standards published in 1979 require RS-449 interfaces, which, in some applications, requires a secondary channel connection to substitute for RS-232C on all federal agency equipment.

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EXHIBIT III-9

LAN CONNECTIONS TO MAINFRAMES

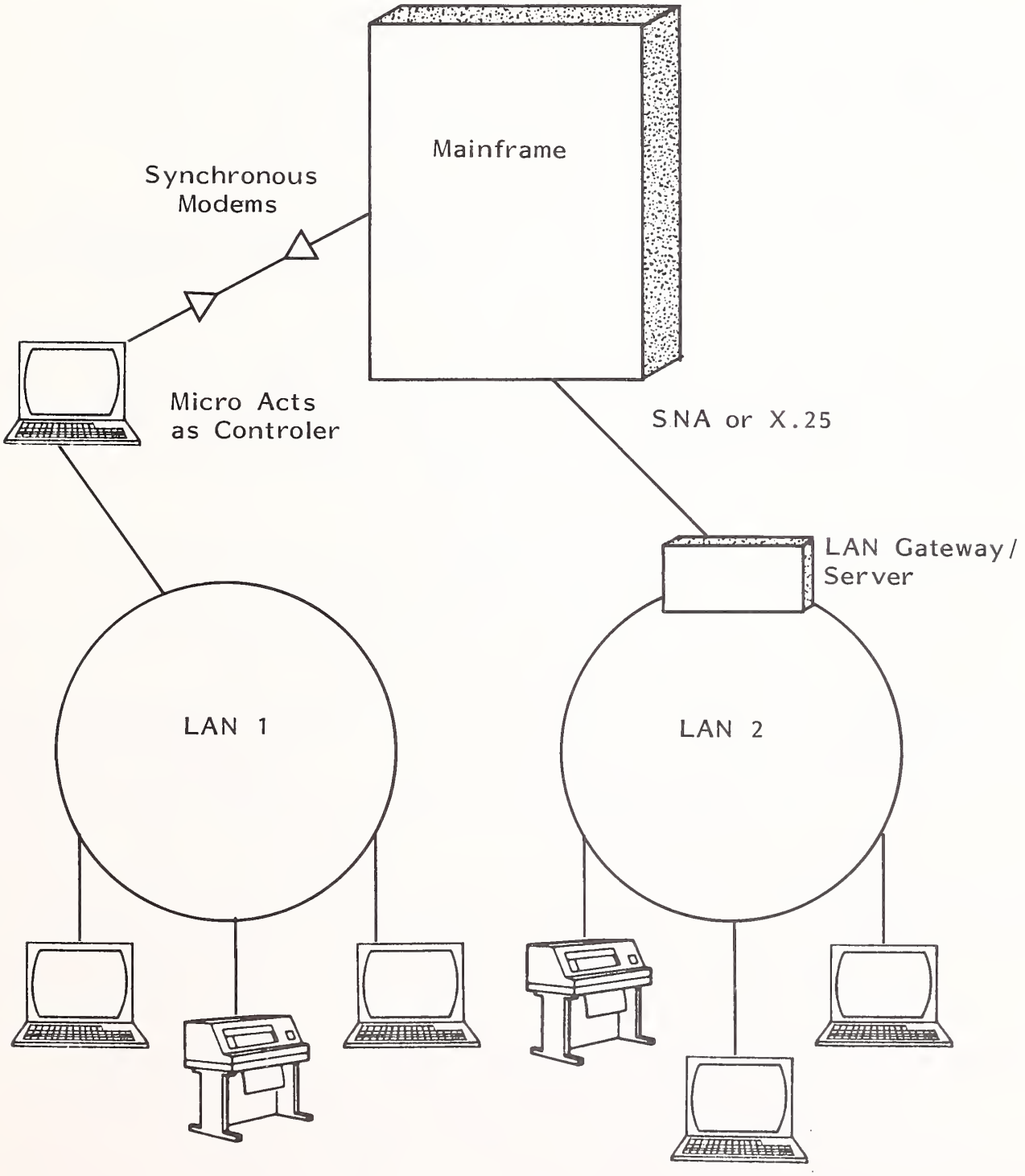

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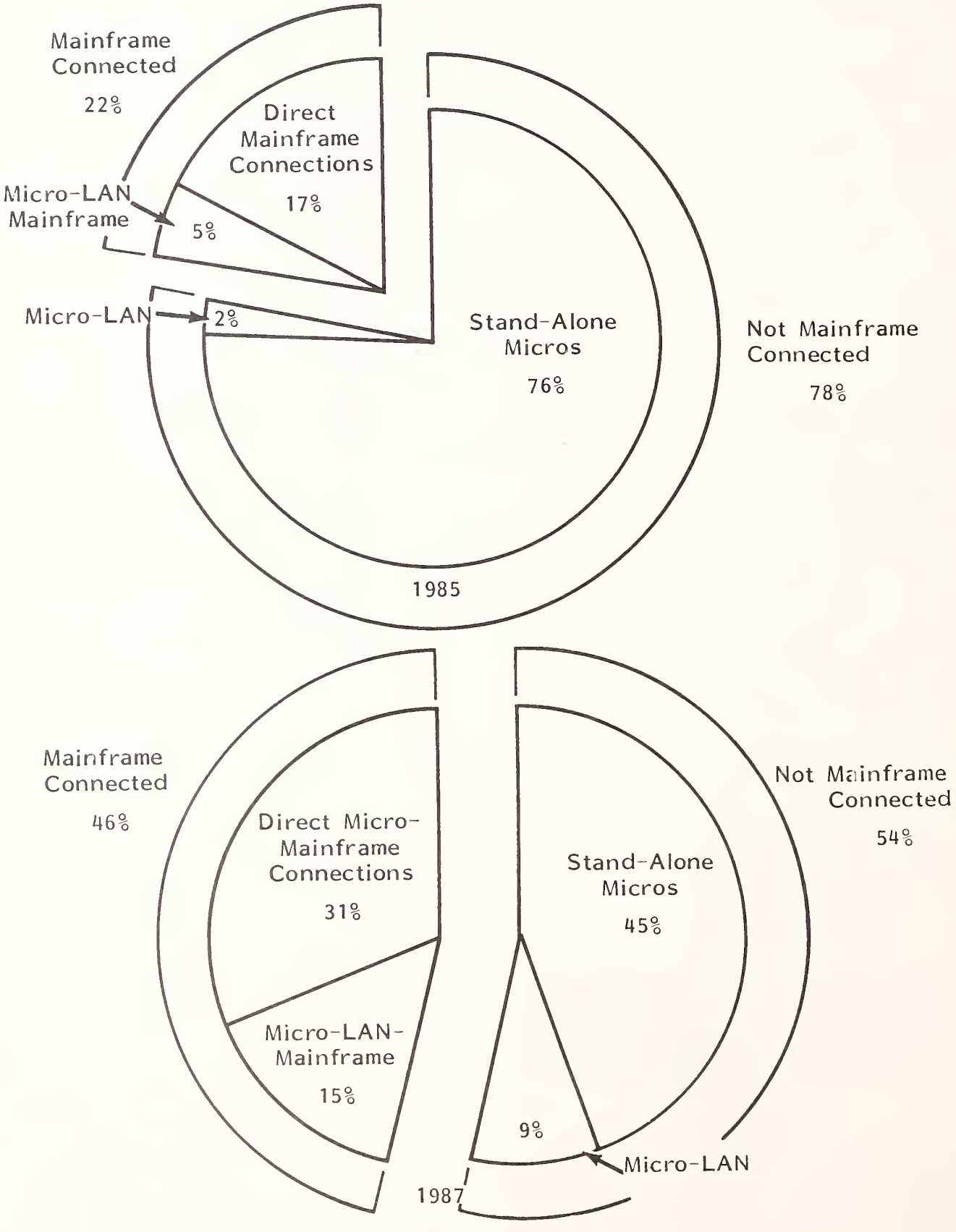
EXHIBIT III-10

M-M CONNECTIVITY BY PERCENT OF TOTAL MICROS
SURVEY RESULTS



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- This means administrators must specify the interfaces needed, which may limit the agency's vendor options and add cost.

- RS-449 interfaces do support greater distance communications than RS-232 (up to 4,000 feet) and higher speeds (up to two megabytes per second).

- It may take some time before RS-449 standards replace RS-232, and it is also possible that RS-449 itself will be superseded by new standards before it is accepted. Except for federal agencies, the issue is not very important.

J. PROTOCOL CONVERTERS

- Originally introduced to allow clusters of inexpensive asynchronous ASCII terminals to emulate more expensive IBM 3270-type terminals, these "black-boxes" also offer another method for linking various micros to mainframes.

- As implied, they translate typically from asychronous, ASCII standards found on micros or asynchronous terminals to EBCDIC, synchronous standards used on mainframes and back again.

- The functions supported by 3270 function keys are assigned to available keys on the terminal or micro, and users can switch between micro and host functions. Error correction is provided on the synchronous link.

- Protocol converters can be accessed remotely on a dial-up basis through integrated modems, offering greater flexibility than traditional 3270-type terminals which require coaxial hard-wiring to the host computer.

- Advanced protocol converters may support auto log-on and log-off functions, password security measures, and simultaneous multiple host access.

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K. NETWORK SERVERS

- Intermediate processors (minis or 32-bit supermicros) can be configured with software to help locate, transport, and use information in both work group, mico local area networks, or for M-M applications.

  - Resources anywhere on the network (or multiple networks) can be located "transparently," that is, without users knowing their exact locations.

  - Ideally, multiple protocols are supported allowing users to select micro workstations based on need and allowing easy upgrading.

  - Intermediate processors can serve as "staging areas" for data or extract files from the mainframe, thus offloading central processors.

    . These extract files are generally provided on request by IS, thus adding a layer of security to M-M applications and protecting primary data base information from unauthorized manipulation.

    . The delay between the request and availability of extract files introduces a risk that information needed by end users is not "real time." This factor must be balanced against the reasons for using this method.

    . Transmission scheduling can be established between the mainframe and the server, with notification of the time of the last update displayed on the micro screen.

- Exhibit III-11 is a simplified schematic showing minicomputers configured as network servers.

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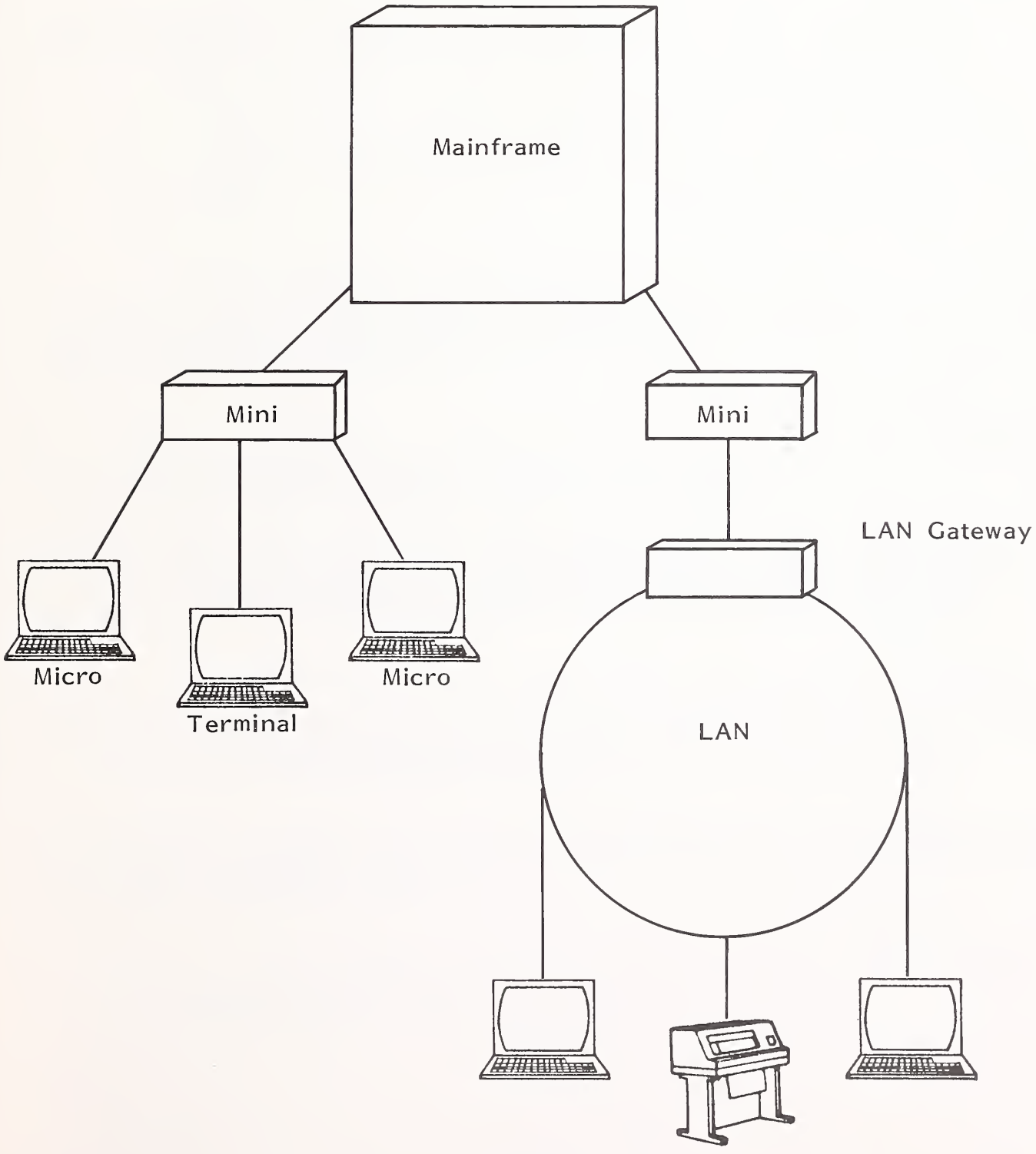
EXHIBIT III-11

MINICOMPUTERS AS NETWORK SERVERS



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L. TELECOMMUNICATIONS OPERATING SYSTEMS

- Respondents were asked to indicate the telecommunications operating systems now supported at their facilities, and to identify which will require micro links by 1987. Facilities may have more than one telecommunications operating system, even on the same mainframe computers.

- Respondents ranked TSO and CICS as the leading telecommunications operating systems currently in use and also requiring M-M links by 1987.

M. CASE STUDY FINDINGS

- M-M applications cover a wide range of objectives and include gradients of complexity. In 1984, INPUT reported on several cases which were in various stages of implementation.

- As companies evaluate the technological options presented by new vendor offerings, there has been little change since the cases were originally described. The current status is categorized by more planning and coordination, with limits placed on how M-M is currently used in this evaluation period.

- It is not important to repeat the details here, however, the cases do provide a good indication of how telecommunications issues are approached in M-M.

- It is important to note that no profiled company included a comprehensive communications plan as part of its M-M planning process. The reasons include:

  - IS planning has fallen behind M-M events in many companies.

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- Telecommunications planning is still somewhat isolated from other IS functions in many companies.

- Applications problems rather than technical issues relating to M-M implementation held higher priority.

- It was assumed that transmission efficiency could be upgraded later once the basic system was operational.

- Using existing wiring was considered more prudent than investing in advanced communications systems which might not be currently appropriate.

- Because LANs are still evolving, with new products becoming available, many companies have postponed installation of these potentially more efficient systems.

- The lack of planning is significant, not only as it relates to the individual cases, but more importantly, as it reflects a general pattern.

  - Without planning the impact of M-M links on a company's communications systems, the true costs of micro-mainframe links are unclear.

  - A company risks communications strangulation as a result of increased network usage due to M-M and other demands on the system, such as growing use of electronic mail.

- For the case details, interested readers are referred to Micro-Mainframe: Telecommunications, 1984.

- The next chapter describes methods of planning for future corporate network communications needs.

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IV COMMUNICATIONS GROWTH ISSUES

- As the previous chapter noted, anticipating the impact of increased communications network loading is often treated as an afterthought which provides the potential for serious consequences. This chapter analyzes ways of planning future needs due to micro-mainframe and other demands.

A. DIFFICULTIES IN PLANNING NETWORK CAPACITY

- In some ways, planning M-M communications networks may be easier than planning conventional data networks.

  - Host processor and communications loads can be limited and controlled by offloading processing and storage functions onto micros.

  - Unless in a 3270 terminal emulation mode, micros cannot currently be operated in real-time with the host. The link may be held open throughout a lengthy session while the micro processes downloaded data.

    . For the intermediate term (the next two years), it is likely that most M-M applications will be batch applications.

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- Batch applications may be easier to design and implement, but they exchange larger amounts of data than purely terminal emulation systems.

- Communications loading for a specific units of work may decrease because the micro end could be very self sufficient and take over many functions now performed interactively with host systems. However, overall loading will increase due to the increasing number of corporate micros for M-M applications.

- Based on INPUT's research, there will be significant growth in data communications due to these factors.

I. OVERALL GROWTH

- In the next five years, data communications traffic could increase between 39% and 70% beyond current projections due to in part to M-M links, as shown in Exhibit IV-1.

- M-M communications will often be more intense than current host-terminal communications. Conceptually, it is useful to view M-M communications as peer-to-peer, computer-to-computer communications in order to understand this fact.

- Widespread, linked micros will also encourage electronic mail, external data base queries, and possibly office or business-to-business videotex. In the future, many locations will use micro-mainframe links for integrated voice and image transfer (compound document functions), both demanding higher throughput and overhead.

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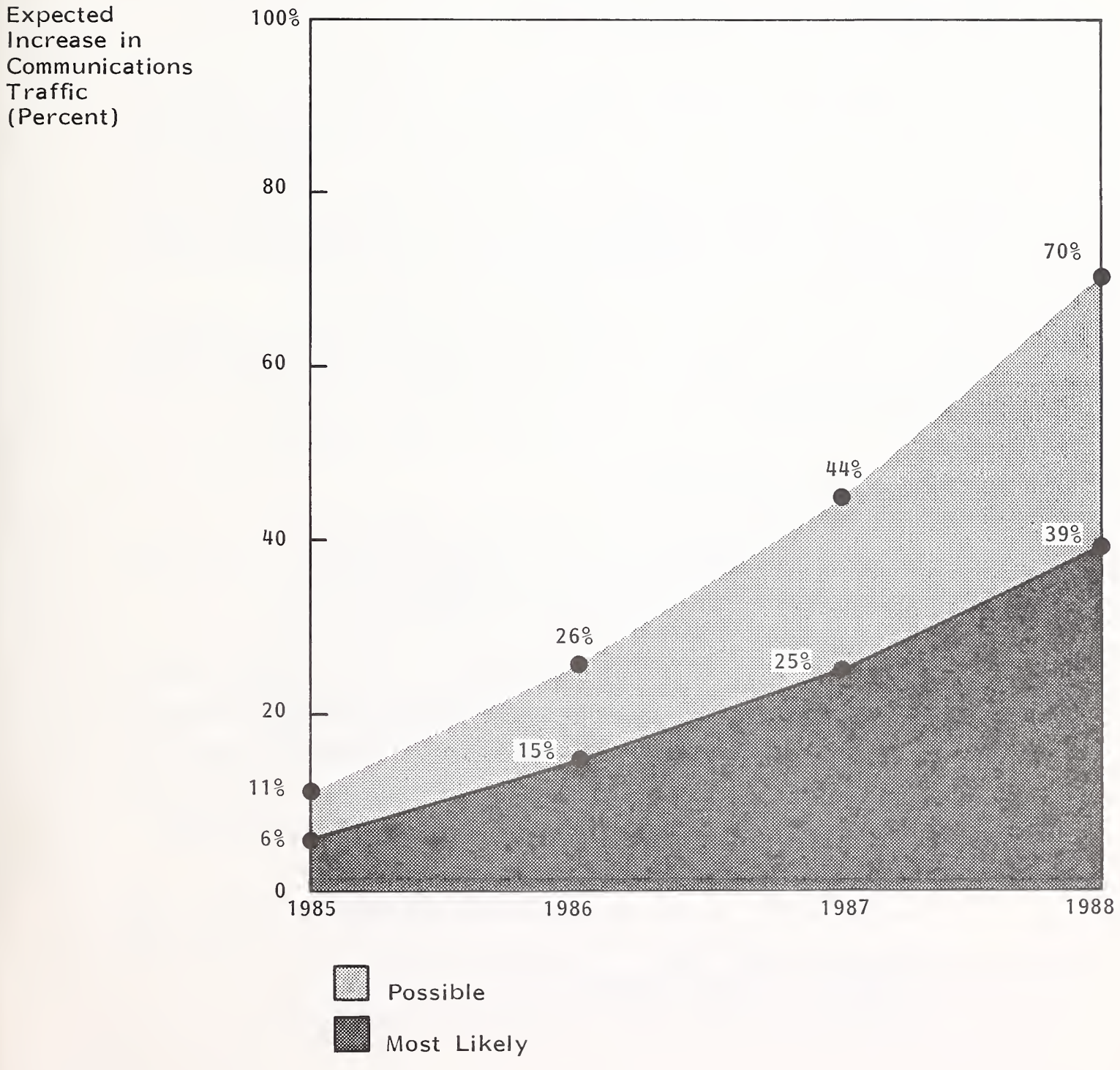
EXHIBIT IV-1

PROJECTED DATA COMMUNICATIONS GROWTH



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2. NETWORK MANAGEMENT AND CONTROL

- The network management and control tasks will be nontrivial. Typically, network control centers are computer-based systems supervising all operations of the network in real time, isolating faults, and indicating specific requirements for network action. Individual components in the network may independently handle some of these functions.

- Network management and control systems have multifunctional responsibilities. These systems monitor links, terminals, gateways switches, and concentrators, maintain back-up links and equipment, restore failed circuits and reconfigure the network automatically. They also handle automatic testing, problem diagnostics, and report generation from decentralized control points.

- Traffic volume and network condition reports provide advance warning on additional network capacity requirements, essential for predicting trends and anticipating problems.

3. PLANNING NETWORK IMPACT

- Determining the impact of M-M cannot be done in a vacuum. It must be part of a broader look at the future needs of the corporation.

- When planning the effects of M-M applications on the corporate network, Telecom managers must consider factors not related to M-M. Some applications may reduce other facility usage. For example, electronic mail (including voice mail) should result in a reduction of voice communications, but still require net increases in computer and network capacity as usage increases.

  - A 1985 INPUT survey of nearly 600 microcomputer software users found that over 40% of the business respondents plan to start using electronic mail in the next 12 months.

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- The same study found that over 50% plan to use micro-based graphics.

- These, and other growth applications, add to demands on the corporate network.

- For the medium term, "on-line batch" M-M applications, where micros perform processing and occasionally exchange data with the mainframe, will be the most feasible design approach. However, user desires and applications needs will drive such systems toward becoming "pseudo-interactive" systems with more frequent, mutual updates.

  - This approach places obvious burdens on communications networks not designed for this relatively infrequent but dense transmission. This is more like computer-to-computer bulk data transfers than terminal-host communications.

  - One favorable factor will be that M-M response times of minutes will often be adequate for these types of transfers.

  - As Exhibit IV-2 shows, communications requirements for host-terminal and M-M batch applications are quite different. An analogy is trying to operate high-speed passenger trains and low speed freight trains on the same tracks--while possible, it requires major planning.

- One problem of communications planning for M-M is that many rules of thumb may no longer be useful and may even be misleading.

  - For example, the number of terminals and the rate of terminal growth is usually correlated with network growth and loadings in conventional host-terminal applications.

  - It is not enough to count micros (assuming this is possible) to get even a rough guide on M-M activity, as the next section clarifies.

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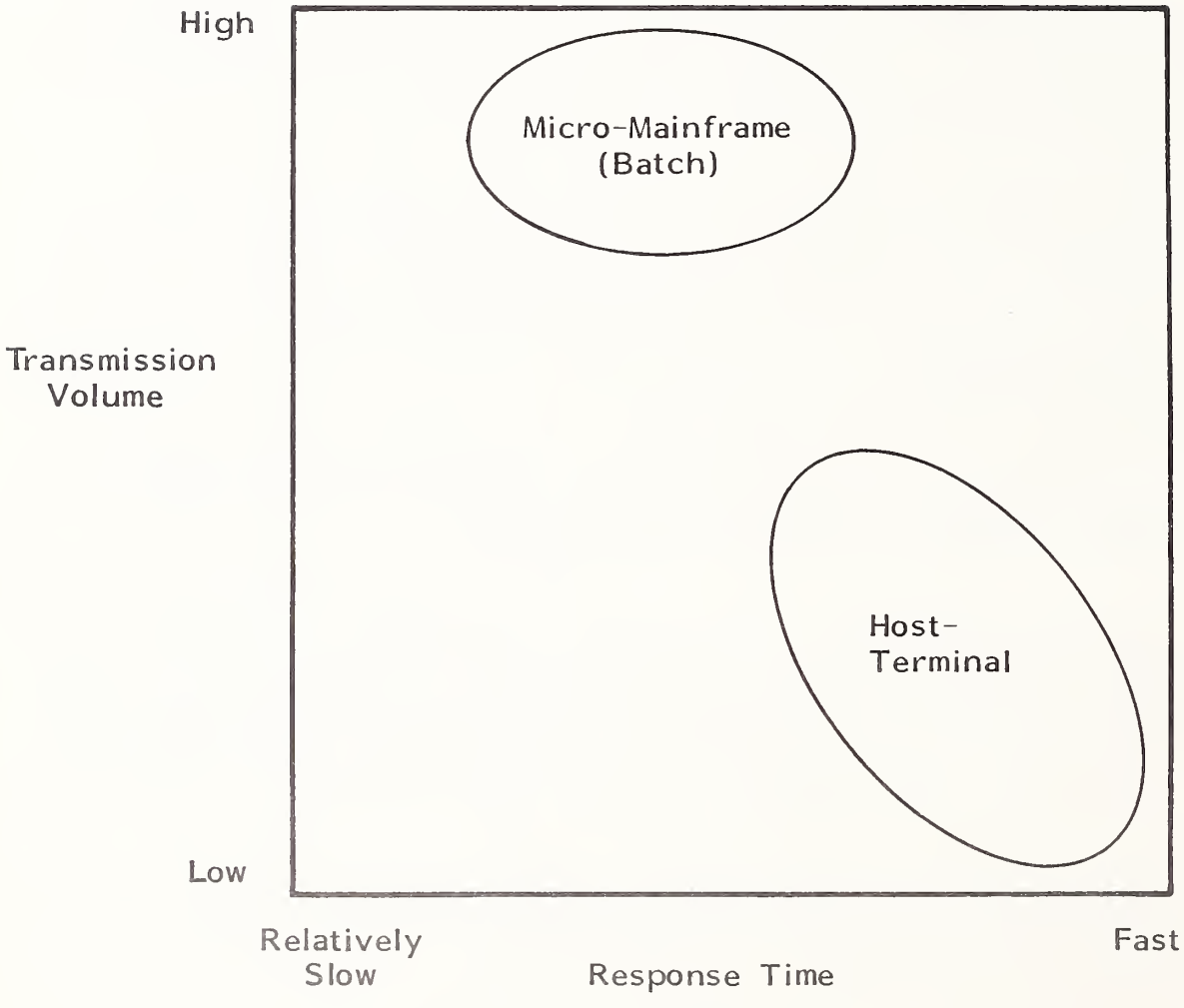
EXHIBIT IV-2

HOST-TERMINAL AND MICRO-MAINFRAME
COMMUNICATIONS REQUIREMENTS



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B. METHODS OF PLANNING CAPACITY

- Capacity planning is a performance-oriented approach to resource management.

  - The loading, use, and response of system resources can be monitored and analyzed.

  - The flow of current and future work through the network can, therefore, be projected and controlled to provide the best overall user satisfaction.

- There are certain fundamental steps in planning capacity:

1. CURRENT REQUIREMENTS

- Quantify the workload by determining current requirements and by categorizing various teleprocessing activities.

  - In addition to reviewing network traffic reports, this will include forms analysis, determining the number of fields to be filled in by production workers, determining the frequency of analysis sessions, and determining the size of transferred files.

  - Factor in transmission reductions made by data compression algorithms featured on specific M-M products.

  - Also factor in overhead added by any planned integrated M-M links for data structuring and control.

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2. RESPONSE TIMES NEEDED

- Determine user requirements.

  - The key to establish capabilities is to define a given level of expected service defined by response time.

  - Batch file transfers are not "real time" transmissions but nevertheless contribute to network loading. Planners must distinguish between real-time and batch needs. Long response times of minutes in batch systems may be acceptable, but for real time needs, such delays are unacceptable.

  - Future parameters, as they are refined, are based on current service levels unless the system is not meeting current needs. Micro-mainframe applications, without improvements to the system, can diminish service levels for terminal users or other network needs.

  - In planning response times, developers often build-in delays when first implementing systems, and later reducing these delays, so the effect of growing traffic on response time is less noticable by users.

3. FUTURE REQUIREMENTS

- Identify growth factors for each functional area.

  - Due to the dynamic telecommunications environment, hardware, software, personnel, and even methods may change quickly. Work to get a handle on these changes by reviewing the corporate and divisional long-range plans, and by talking with key managers.

- Recognize that as the network approaches full capacity, there is an exponential loading factor created by users repeatedly making attempts to gain

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network access after failing to do so. This means that demand on the network is not truly reflected as this point is approached due to this cascading effect.

- Project future resource requirements by taking into account increasing numbers of users, increased use per user, new technologies, new software releases, and other considerations identified in the planning process.

4. HARDWARE CONSIDERATIONS

- Plan for hardware upgrades by realistically calculating the practical capacity of existing equipment.

  - Estimate, by introducing a growth/load factor based on the above analysis, what you will require of any new or modified system.

  - Select appropriate hardware by choosing only those systems that meet current and anticipated capacity. Although this step may seem obvious, for some reason, planners often only include current needs when considering new equipment.

- An early step would be a hardware capacity study, including both long- and short-term business plans. First, estimate current resource use and then estimate new requirements. Finally, do a technology forecast on all hardware and software.

  - Consider the impact of new minis and micros in the micro-mainframe configuration to define mainframe sizing requirements.

    . When there is more local processing of data, more resources become available for telecommunications.

    . However, widespread usage of M-M works against this dynamic, resulting in net gains for both central processing and telecommunications facilities usage.

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- Next, anticipate additional use from new applications tied to emerging technologies such as fiber optics or microwave.

- Finally, develop an upgrade path for all equipment. As requirements grow, so will system needs. Work to stagger obsolescence schedules. It is frustrating and expensive if most equipment must be replaced at the same time.

5. OPERATIONAL CONSIDERATIONS

- It may be necessary to restrict use of the network. This can be accomplished by limiting large-scale usage for such functions as mainframe-mainframe data back-ups to off hours.

- Existing and planned system use must be controlled.

  - Centralize all hardware and software acquisitions; failure to do so can lead to chaos.

  - Carefully monitor planned use against actual use and adjust long-range plans accordingly.

C. METHODS OF MEASURING CAPACITY

- Measuring M-M telecommunications capacity is similar to the methods used for other data or voice analysis. They include:

  - Determination of load lines.

  - Use by channel, communications controller, multiplexer, etc.

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- Transactions per unit of time.

- Response time by transaction and by transaction type.

- Total number of transactions.

D. TOOLS ARE AVAILABLE

- Telecom managers are familiar with the manual methods of calculating capacity needs, response times, and configuring networks. Increasingly, computerized tools are available to handle these time consuming tasks. Some are available in microcomputer or mainframe formats, while others are accessible through time sharing.

- These tools are generally expensive and are intended for designing entire, wide area corporate networks, not just M-M.

- Companies providing these products include CONTEL (Grinder, Mind-Data, Mind-Voice), Connections (Multipoint Network Design System), System Engineering Tools, Inc. (SET: POINT), and IBM's Response Time Estimator for 3270 environments.

- Use of these tools, or manual methods, must take into account the significant amounts of network processing and storage overhead needed for control and, especially, to manage logically overlapping, but physically separate data bases.

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E. CORPORATE COMMITMENT IS NECESSARY

- Planning capacity has corporate value, and this should be stressed in obtaining managing commitment to the planning process.

- In the formal plan, highlight how planning permits you to predict additional capacity needs in anticipation of requirements.

  - Be realistic in those estimates. This forms the basis for anticipated expenditures and assists budgetary justification.

  - It also helps to maintain the required service levels, with the additional bonus of being able to select upgrades fitting present and future needs.

- Finally, capacity planning provides important information necessary to negotiate effectively with vendors for upgrades or new acquisitions.

- Exhibit IV-3 is a check designed to assist in determining how to analyze and plan network capacity requirements for M-M.

F. COMPONENT GROWTH FACTOR

1. LOCAL AREA NETWORKS

- INPUT's research indicates a seven-fold increase in the number of LANs used for M-M functions (as reported in the last chapter).

- Twenty-nine percent of the respondents report using LANs now and 58% project they will have LANs by 1987.

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EXHIBIT IV-3

M-M NETWORK CAPACITY PLANNING/ANALYSIS CHECKLIST

CURRENT WORKLOAD

- Traffic Reports
- Forms Analysis
- Session Frequency Analysis
- File Size Analysis
- Reduce by Data Compression Factor
- Increase by Data Structuring and Control Overhead Factor

FUTURE WORKLOAD

- Growth Factors for Each Function
- Growth Factors for Increasing Number of M-M Users
- Other Growth Factors

HARDWARE CONSIDERATIONS

- Current Capacity
- Estimated Growth Load Factor
- Impact of New Technologies (i.e., Fiber Optics, Microwave)
- Choose Hardware Matching Future Needs
- Stagger Obsolescence Schedules

OPERATIONAL CONSIDERATIONS

- Restrictions/Scheduling
- Centralized Acquisition
- Monitor Actual Against Planned Use and Make Adjustments

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- Five percent of the respondent's micros are now linked to mainframes or minicomputers through LANs and, in 1987, that percentage will grow to 15% of installed micros.

- IS evaluation of LAN products needs to include a review of specifications to determine the suitability of individual LANs as a component in M-M connectivity.

2. CLUSTER CONTROLLERS

- Micros accessing the mainframe may directly connect to the host or connect through a cluster controller via coaxial cable.

- Coaxial connection costs can be reduced if the controller is located near the micro work group. Specifications must be checked to verify cable lengths supported, and host software must be modified, adding new terminal addresses if required.

- It may be desirable to install new cluster controllers to service micros used for micro-mainframe applications.

G. FUTURE ECONOMICS

- IS should resist the tendency to become immobilized because future developments may offer better solutions. Productivity gained with today's tools can be substantial while waiting for the ideal solution.

- From a telecommunications perspective, enhancing the value of the corporate network is an important undertaking. Increasingly, these facilities are seen as corporate assets rather than cost centers.

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- IS and Telecom can use this period to learn about M-M, users requirements, products, and their impact on communications, implementing when it appears available tools will most likely fit current needs. These methods may serve for several years or they may be modified later to take advantage of technological improvements.

I. JUSTIFICATION

- While cost justifying M-M links was ranked a key problem by only 3% of the survey sample, it is INPUT's experience that significant investments in new systems requires some form of cost/benefit analysis.

  - The low rating may be reflecting the fact that M-M is still largely experimental, primarily using terminal emulation methods built on low cost, add-on boards.

  - It may also be interpreted to mean that IS management is as yet unaware of the expense involved in M-M implementation and, particularly, of the hidden telecommunications costs involved.

  - Senior management will start evaluating M-M costs when it emerges beyond relatively inexpensive terminal emulation, board-based implementations.

- With the high prices of advanced M-M links, the costs of IS time and effort required to customize these links, and required network investment, justification will be required of IS and Telecom by most management structures.

- Justifying any computerized system is appropriately based on increased productivity, but IS managers have difficulty in quantifying these increases.

- INPUT's 1983 study Impact of Office Systems on Productivity identified interpersonal communications as the largest time/cost factor in the office

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with analysis and decision making second. Micro-mainframe applications serve these functions well.

- The IS manager may attempt to demonstrate M-M productivity improvements by prototyping systems and evaluating the change "before and after." Such analysis is often time consuming and difficult.

- Increasingly, intangible benefits (increased effectiveness, quality of work, productivity) are used to justify office system implementation. However, conservative managers sometimes require "bottom line" tangible justification (cost displacement, reduced personnel costs, reduced backlog). They require new system expenses more than displaced old system costs.

- Because of the need to justify new systems, INPUT issued a companion study, Methods of Cost/Benefit Analysis for Office Systems.

  - This study recommended awareness of management types in order for justification to be consistent with their requirements. While conservative managers require hard figures, more progressive managers are interested in business opportunities, soft dollars, and intangible projections.

  - The most commonly cited intangibles were productivity linked, value-added benefits, such as improved analysis capabilities.

- This report cautions that the overriding weakness of such techniques is that too much time and money can be spent on the process.

2. PRICING THE PIECES

- Pricing is related to timing and is a more practical matter to consider.

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- Currently, M-M software products offering substantially similar capabilities range in price from a few thousand dollars to over one hundred thousand dollars, with the main differences being functionality and bundled products/services.

- With time, the effects of competition will undoubtedly smooth out these vast differences, making possible comparisons based on functionality rather than price.

- Pricing the communications elements of M-M is a more difficult process, requiring detailed analysis of the specific planned configuration. These elements span the range of telecommunications products, from cables to controllers, to communications processors, and beyond to the recurring costs of packet or satellite networks, and the management of those facilities.

- As with planning capacity requirements, communications cost planning for M-M cannot be done in a vacuum. The entire networking puzzle needs consideration, and M-M is only a part of the system.

- M-M communications costs will be an incremental part of network costs due to additional traffic for both interactive, transactional applications, and file transfers.

- M-M implementation pricing should be stated in terms of individual user costs, rather than as the total package price. Not only is this lower price easier to comprehend, but it allows evaluation based on the value of each worker's effort and provides a basis for charging costs to end-user departments.

3. TIMING AND RISK ANALYSIS

- Timing implementation becomes a matter of finding the window of opportunity for methods which solve more problems than they create.

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- IS runs a risk of implementing too soon, and with tools which are currently inadequate for the job or with networking overkill, with unused, wasted capacity.

  - IS and Telecom must become as skilled at prognosticating as they are at understanding technical issues.

  - They must meet their respective professional responsibilities to management by making available productivity tools and linkages.

  - They also need to use people skills in balancing end-user demands with the technologically possible and to make management and users aware of the potential risks, thus sharing those risks.

4. LINE SPEED AND UTILIZATION COST CONTROLS

- As easier to use M-M links are installed, more frequent access is encouraged. These user friendly implementations add overhead to the communications links for control and data structuring.

- Communications costs, both in terms of line charges and holding times, can be reduced by using higher speed modems, as described in Chapter V, Section D.

- Cabling costs can be reduced by using coaxial multiplexers which allow multiple devices to communicate over a single cable. Several vendors offer such multiplexers, supporting from 8 to 32 devices.

- Installation costs can be reduced by using fire resistant cable conforming with National Electric Code Standards which can be used in suspended or dropped ceilings, eliminating the need for cable conduits.

- Settings requiring intra-building communications can control costs with various current bypass methods and by using future packet services to be provided by the Bell Operating Companies (discussed in Chapter V).

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- Synchronized links compress data into existing network capacity and when increasing common carrier tariffs make it necessary, asynchronous communications should be analyzed to determine the payback period of new equipment supporting synchronous linkages.

- Bypass methods, future market trends, and technological advances impacting M-M connectivity are discussed in the next chapter.

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V FUTURE DIRECTIONS—MEETING UNMET NEEDS

- Products serving M-M needs are still evolving with new introductions virtually every week. Many products are being pre-announced, and it is likely some of these will fail to reach the market.

- Regardless of individual product failure or success, the technology advances and the market churns, making choices more difficult. Goethe wrote, "Coming events cast their shadow before." With a little future gazing, developments can be anticipated, thus informing decisions.

- New communications products and services must also be considered as part of M-M deliberations. If M-M applications reach significant levels, they, combined with other communications growth areas, will impact the corporate network.

A. VENDOR ALLIANCES

- As shown in the recent history of M-M product development, vendors are joining forces to solve problems.

  - Existing mainframe and minicomputer data structures are being opened to specific micro-based products to permit downloading directly into microcomputer data base or spreadsheet applications.

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- This trend will continue as software vendors seek to extend their principal products' utility.

- Alliances based on hardware are also significant, perhaps best represented by IBM's acquisition of Rolm.

  - Rolm has introduced a series of products which merge voice and data communications in microcomputers. These products can be taken as indicators to both IBM's and the market's voice/data integration intentions.

  - Other computer firms have entered alliances with communications vendors, similar to, but not as comprehensive as, IBM's acquisition. Integrated voice/data products are available from several companies, including AT&T.

B. THE IDEAL

- The best M-M implementation is the one which works best for the individual need. Simple data base access can be done through terminal emulation, although this has the effect of reducing an intelligent microcomputer to a dumb terminal, albeit sometimes with downloading capabilities.

- A generic ideal M-M implementation automates tasks which otherwise require knowledge of the mainframe's command structure.

  - This means simplified log-on procedures, menus, on-line help facilities, and a micro-based data dictionary--essentially a directory to the various data bases, applications, and services accessible through the system.

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- As the ideal becomes reality, easier operations will mean more M-M applications and increased demands for communications services.

- Advocates of distributed data processing see the ideal consisting of many network nodes (minicomputers), each with resident data. The end-user's node locates requested information anywhere on the network and converts it to micro format.

  - The process is transparent; users are not required to know data addresses. The minicomputer's intelligence also handles conversion and communications between the dissimilar systems.

  - This method offers communications economies, since traffic can be concentrated between the node and the mainframe rather than using single line links between the micro and mainframe.

- The features of the ideal M-M link are shown in Exhibit V-1.

C. MICRO CAPACITY

- The memory storage and processing capacity of micros are increasing. Some feel that micros will eventually have as many capabilities as mainframes, both individually and through shared resources on local area networks.

  - Laser disks, eventually with economical read and write capabilities, promise increasing local storage capacity. This means that each micro can have a copy of at least part of the master data base normally stored on the mainframe.

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EXHIBIT V-1

THE IDEAL MICRO-MAINFRAME LINK

- Automated
- Simple Log On
- On Line Help
- "Fill-In-the-Blanks" Query
- Natural Language Interface
- Micro-Based Data Dictionary
- Transparent Conversions
- Concentrated Communications

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- Advances in integrated circuits and the expected 1986 availability of "megachips," capable of storing over one million rapidly accessible bits, promise to bring much of the processing and storage power of mainframes to desk-top units.

- The integration of voice and data capabilities also indicates a trend to communicating micros.

- The implementations for IS are clear:

  - With the increasing communications capabilities of micros, distributed data base management will emerge as a key IS task. With massive local storage available to end users, concurrency with the central data base needs to be insured with procedures and schedules for uploading distributed, revised information.

  - IS also needs to justify maintaining expensive central storage and processors when every individual or work group has substantially the same capabilities and communicates freely throughout the organization. This justification can be based on the corporate need to have centralized data available.

  - Distributed information must still be managed and transported through the organization, creating demands on the network, not only with the data flows but with the associated control and structuring overhead.

- These are not easy issues to face, but fortunately they are not immediate concerns. IS does need to monitor developments in order to inform its long-range planning, estimate the timeframes these, or any, advancements will become cost-effective, and plan today's systems and methods so that new technologies can be easily incorporated when available.

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D. FASTER MODEMS

- Remote access for M-M sessions can be done through leased lines, but occasional needs do not justify this expense.

- Access through value added networks is an option, as are virtual private networks. Virtual private networks are established within the public network and dedicated to a sole corporate user. However economical, occasional access through VANs requires connecting through dial-up ports which support limited speeds. Accordingly, direct dial-up links to the mainframe are often more desirable.

- In the past, this access was limited to speeds of 1,200 bps, but modems supporting dial-up, full duplex 2,400 bps operations are now commonly available.

- Further, in 1984 the V.32 standard was approved by the international standards organization CCITT for full duplex, 9,600 bps dial-up communications. These may be used for both synchronous and ansynchronous communications.

- Only one vendor currently offers V.32 modems; however, INPUT expects others.

- V.32 modems offer the advantages of faster transfers and reduced line changes, but they are currently expensive, costing upwards of $3,000 while lower speed modems (e.g., 2,400 bps) are priced between $700 and $900.

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E. MNP—COMMUNICATIONS PROTOCOL STANDARD OF THE FUTURE?

- The Microcom Networking Protocol (MNP) error correcting protocol will probably be submitted for certification to the American National Standards Institute and the CCITT.

  - Modem manufacturer Micocom took the unique strategy of separating the protocol from its communications software, thus making it machine independent and offering the protocol to vendors for incorporation in hardware and software.

  - A number of firms, including IBM, Apple, Tandy, Visicorp, GTE Telenet, and AT&T are already embracing the protocol which is modeled after International Standards Organization (ISO) specifications.

- If, as expected, MNP becomes an official (or at least de facto) standard, use of products incorporating it will alleviate the problem of having to accommodate multiple communications protocols for remote micro-mainframe communications.

F. LOCAL AREA NETWORKS

- Section H of Chapter III reported respondents plans regarding LANs used to connect to mainframes or minicomputers.

- While LANs will primarily be used to share data and peripherals in work groups, they will increasingly be used for M-M linkages.

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- Vendors are starting to take the M-M tack in their marketing efforts, with LAN communications servers offering an alternative to individual M-M linkages and the use of intermediate processors.

- LAN servers handle communications and conversion tasks and may serve as holding areas for extract or intermediate files currently being used by micros linked to the LAN.

- Technological improvements driven by VLSI technology will add flexibility to LANs while lowering prices.

- A less expensive LAN, fully compatible with Ethernet standards, is expected to be endorsed by the Institute of Electrical and Electronics Engineers (IEEE).

  - Called Thin Ethernet or "Cheapernet," this LAN operates at the same 10 megabits-per-second speed of Ethernet, but for 200 rather than 500 meters without repeaters.

  - Thin Ethernet uses less expensive, thinner cable and BNC connectors. It is more pliable and can be installed by users.

  - Due to on-board chip sets replacing network transceivers, per node prices are expected to be approximately $100 rather than the $1,000 node price of Ethernet.

  - Thin Ethernet can accommodate only 30 nodes per segment, compared to the 100 nodes supported by Ethernet. However, several segments can be joined and, due to compatibility, segments can be connected with larger Ethernet systems.

  - Thin Ethernet is suitable for departmental networks.

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- European manufacturers and U.S. LAN manufacturers Ungermann-Bass and 3Com are already supporting this less expensive standard, as are several computer vendors. Several other supporters are expected.

G. CBX—THE "FOURTH GENERATION" VOICE/DATA PBX

- Any view of M-M linkages should also consider so-called "fourth generation PBXs," which INPUT refers to as CBXs (computerized branch exchange).

  - These voice/data switches are distributed processors which integrate LANs by design and form the core for corporate office automation and telecommunications.

  - Due to their modular design, CBXs can be easily upgraded for increased capacity.

- Despite vendor claims that CBXs digitize data, the physical switching equipment is analog. Data capabilities are supported by the resident software. Since CBXs use twisted pair as the transmission medium, speed is generally limited to 9,600 bits per second. This limitation may not be a problem for many M-M applications, but for others requiring large file transfers, the delays caused may be unacceptable.

- There are political and organizational implications for data processing and micro-mainframe implementations, since CBXs involve both the voice and data telecommunications sides of IS which may not be accustomed to working together on joint projects.

- As the installed base of earlier generation switches become obsolete, CBXs will become more common, bringing with them M-M capabilities suitable for many users.

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- IS needs to be aware of this approach to merging voice and data functions to aggregate resources into one integrated system.

- Those using or considering CBXs for micro-mainframe should be aware of two alternate proposed interface standards for computer-to-CBX links.

- These interfaces are designed for the coming Integrated Services Digital Network (ISDN) environment, which is envisioned to become the standard network format integrating voice, data, and image within 10 years. ISDN will replace modems with digital interfaces and be built around T-1 carrier standards.

  - ISDN will incorporate 64 channels each for voice and data, and 16 channels for signalling.

- The two specifications are:

  - Digital Multiplexed Interface (DMI) proposed by AT&T. DMI is not yet available, but it will fully match ISDN standards when they are fully determined.

  - Computer to PBX Interface (CPI), jointly developed by Digital Equipment Corporation and Northern Telecom, is available. Its supporters are focusing on the need for an immediate implementation in preparation for ISDN.

- The goal of both proposed computer-to-CBX standards is universal acceptance, while reducing costs and complexity.

- Notably missing from those committed to either interface is IBM, although it may be presumed the company will defer to its wholly owned subsidiary, Rolm, on this matter. Rolm is supporting CPI.

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- Many feel the battle lines being formed behind these proposed standards represents competitive positioning, and they may very well merge in the future. Several computer and PBX companies say they will support both specifications.

- The technical differences between the two proposals are minor. From the telecommunications manager's perspective, support of either standard is not a significant factor in selecting communications equipment at the present time. It is important to be aware of the controversy to permit fair evaluation of new equipment claiming to support either standard.

- CBX issues are analyzed in INPUT's 1985 report LAN/CBX: Planning for Change.

H. FIBER OPTICS

- Fiber optic links are now being used in some specialized networks, and the use of this medium, both internally and through common carriers, will continue to grow, providing increased integrated voice, data, and image communications capacity.

- As usage of this technology grows, standardized, mass produced fiber optic components will become more cost-effective, working to reduce networking costs.

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I. INTERNAL X.25 NETWORKS

- Packet switching networks optimize facility usage and while public value added networks offer services suitable for wide-area communications, X.25 networks can also be configured for internal corporate use, either operating independently or as virtual networks within the public VANs.

- Due to recent FCC authorization, the regional Bell Operating Companies (BOCs) will likely be offering intra-LATA (Local Access and Transport Area) asynchronous to X.25 conversions and possibly IBM SNA services, with links to national packet networks.

  - These new services will require end users to lease local digital lines to packet network nodes (although dial-up access will also be provided) and pay port connection and usage charges.

  - Corporate users will also need to buy or lease channel select units (CSUs) and multiplexers on both the user and network sides.

- The availability of these proposed BOC offerings requires evaluation based on company needs and the costs of competitive, existing VAN services. These comparisons are not easy. The various services are configured differently, with varying tariffs which may or may not include all needed equipment.

- The key advantage to using public VANs, virtual private networks or intra-LATA services for micro-mainframes, is that users do not have to be concerned with maintenance or other factors which may add costs because network management is the responsibility of the vendor.

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J. OTHER ADVANCING COMMUNICATIONS TECHNOLOGIES

- The future will offer innovative M-M approaches using the subsidiary communications authority (SCA) of FM radio stations and the television vertical blanking interval (VBI).
  - Recent FCC actions have opened these frequency resources for data, and a number of companies have implemented or are exploring uses.
  - The technology is currently limited to one-way distribution, but companies involved in SCA are forming relationships with value added networks to provide the return loop.
  - Receiving equipment stripping data from the signal is available.
- SCA or VBI can be used to economically distribute mainframe data to dispersed locations within a metropolitian area, or nationally.
  - In a local area, channels would be leased from a broadcast station.
  - Broader distribution would use one of the television networks or quasi-common carrier companies providing SCA service through affiliated FM radio stations.
- It may become possible to use the frequencies for two way data flows, but this technology is at least five to ten years in the future.
- Related technologies adapting paging technologies to data are available using other radio frequencies (800 and 900 mHz).
- There are other, currently available options to be considered for the corporate network when traffic levels driven by M-M and other applications indicate

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other solutions may be more cost effective than current, more common methods. These include T-1 carriers, lightwave, digital termination services, analog microwave, systems and satellite systems.

- It is beyond the scope of this report to fully explore how these "bypass" technologies fit the M-M issue; however, they do form part of a necessary larger view of corporate communications which may be impacted by M-M.

K. IBM DIRECTIONS

- Since M-M is largely an IBM world, and since the IBM Personal Computer is the de facto industry standard, understanding IBM's intentions and directions is important in planning M-M implementations.

- IBM has identified the general development of communications software as a top priority, but it needs to overcome the past piecemeal development and enhancements made to its family of products.

- The company has increased its programming staff and will work to enhance systems network architecture to serve decentralized needs.

- The success of the PC underscores the strategic importance of M-M communications software. Its users have often had to look to other solutions in the absence of fully integrated products from IBM.

- To support micro-mainframe, IBM does not offer a range of products:

  - The Personal Decision Series (PDS) of productivity tools links with "Attachment" products to IBM's "Business Management Series" on System/36 and System/370 with access to microcomputer DOS files and DIF file conversions.

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- They give users virtual disk sharing options, with conversion between EBCDIC and ASCII, as well as security functions.

- In the future, IBM will need to provide versions of these products that link to other IBM mainframes.

- On the hardware side, IBM offers:

  - The 3270PC, which allows windowed multiple host access with simultaneous personal computing abilities.

    . Data can be transferred between windows.

    . The 3270 PC communicates with any System 370, 308X, or 43XX through a 3274 controller.

  - The PC XT/370 and the faster PC AT/370, as the names imply, work as micros, as System/370 VM/CMS workstations, or as 3277 display terminals.

    . Switching between modes is done with a few keystrokes.

    . Data can be downloaded for manipulation, reporting, and program development and then uploaded back to the host.

- IBM also plans to link the PC network to a future token-ring LAN. While its cabling standard has been announced, the introduction of this LAN is delayed by software development.

- IBM has been promoting a set of extensions to SNA, including Advanced Program-to-Program Communications (APPC) and Logical Unit (LU) 6.2 protocols to be used in host-host links and for pass through to noncompatible devices in the IBM environment.

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- Logical Units form the basis for terminal and application communications.

- By referencing VTAM tables, an LU application determines how to communicate with a terminal.

- LU 6.2 protocols permit document transfer and central control between distributed nodes in the SNA network, in many cases bypassing the host.

- LU 6.2 provides a high-level, standard interface with SNA applications.

- 3274 cluster controllers could also be bypassed, allowing direct communications with mainframes through 3705 communications processors by using a related SNA enhancement called Physical Unit 2.1.

- APPC/LU 6.2 replaces the current file and screen orientation of 3270 terminal emulation packages, permitting micros and minis to work intelligently in a peer-peer, rather than master-slave relationship. The mainframe views the PC as a network resource.

- In this relationship, applications are working with other applications, hence the APPC label.

    . 3270 emulation boards, synchronous modems, and synchronous data link control (SDLC) boards would be eliminated with the new protocols.

- Currently, LU 6.2 is only supported on CICS/VS mainframe software.

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- Part of this family of SNA extensions is Document Content Architecture and Document Interchange Architecture (DCA/DIA) software.

  - DCA describes document formatting.

  - DIA defines how documents are transported through SNA.

  - DIA/DCA will become a de facto protocol standard, and vendors are developing ways to attach non-IBM equipment.

- Other vendors are expected to support these protocols in the future.

- Additional links, particularly between the Distributed Office Support System (DISOSS--a mainframe program supervising large, shared, document files), Professional Office System (PROFs) and, perhaps most importantly, PCs are still needed to effectively integrate office automation and data processing functions.

- Further development of M-M software by IBM is expected and will be introduced over the next few years, but this delay is undoubtedly causing cautious IS approaches to M-M.

L. OTHER VENDOR DIRECTIONS

- Other vendors are not oblivious to the growing demand for M-M.

1. DIGITAL EQUIPMENT CORPORATION

- DEC's stated strategy is to support the multivendor, open systems interconnect (OSI) model. Its minicomputers are marketed as departmental systems, serving as network nodes and configured with office systems software.

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- The company says it will continue to introduce networking products for the VAX/VMS computer family and to increase functionality in new and existing VAX/IBM-SNA interconnect products.

  - For example, DEC offers integrated terminal emulation, file transfer, and Ethernet communications capabilities on the MicroVAX I personal computer which operates under modified versions of VMS and UNIX.

  - Central to DEC's strategy is the DECnet/SNA Gateway to support transparent communications between the two network environments.

2. DATA GENERAL

- DG has a similar philosophy and also markets its minis as departmental office systems serving as network nodes.

  - DG's product line includes micros with integrated communications capabilities operating under its own operating systems. These can emulate both their own and IBM terminals.

  - IBM PCs and compatibles can be connected to DG's MV series of minicomputers.

3. AT&T

- While AT&T does not offer mainframes, it is firmly behind UNIX which is designed to facilitate communications between diverse computer brands and sizes. UNIX is seen as an alternative to IBM's multiple and incompatible operating systems.

  - AT&T has endorsed Amdahl's UNIX-based mainframe, but is focusing its own efforts on smaller, multiuser systems.

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- IBM PCs and compatibles can connect to AT&T's B series of minicomputers.

M. MICRO-MAINFRAME EVOLUTIONARY TRENDS

- M-M currently requires a piecemeal approach in implementation. While vendor alliances and product refinements are making implementation easier, the final resolution to the problem may well be the integration of M-M capability to the point where it is no longer a separately identified issue.

  - New mainframe software products will "build-in" M-M capabilities. Microcomputer hardware may also incorporate the functions required (such as protocol conversion) to effect transparent links, eliminating the need for micro application software, add-on boards, or standalone converters.

  - Intermediate processors (minicomputers) with resident software aiding end-user navigation through mainframe data is another alternative. These processors download and transform information into the formats needed by the micro. To a certain extent, this is already occurring.

  - More micro versions of mainframe software will become available along the lines of Information Builder's PC Focus. These adaptations ease accessibility to mainframe data.

- These trends toward integration support the view that current M-M methods are intermediate tools used for distributing mainframe information structured in various ways to users. More comprehensive and economical solutions to this complex problem will eventually become available.

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- The key question is "when," and can IS or users wait for them?

- The answer is that interim solutions can and should be installed if there is a current need for M-M applications.

- Telecommunications managers should recognize that while piecemeal approaches may not be elegant, they represent the continuing evolution of the technology and do not differ greatly from the way other connectivity problems are solved.

- The channels supporting M-M need to be planned, incorporating a long-term vision so that future enhancements of M-M can be implemented with minimal network adjustment.

- The key market and technological trends affecting M-M are shown in Exhibit V-2.

N. TIMING FUTURE DEVELOPMENTS

- Users should resist the tendency to become immobilized because future developments may offer better solutions. Productivity gained with today's tools can be substantial while waiting for the ideal solution.

- Users can seize this time for learning about M-M, user requirements, and demands on communications facilities, and for thoroughly evaluating M-M products, implementing when it appears an available tool will most likely fit current needs, and planning for the impact M-M will make on the corporate network.

  - These methods may serve for several years or they may be modified later to take advantage of technological improvements.

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EXHIBIT V-2

M-M MARKET AND TECHNOLOGY TRENDS

- Vendor Alliances
- Integrated Functionality
- More Micro Capacity
- Faster Modems
- New Protocol and Interface Standards
- Less Expensive LANS
- New Bypass Techniques
- IBM and Other Vendor Product Developments
- Intermediate Processors

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- The next chapter discusses recommendations for implementation and offers conclusions with particular attention to the connectivity aspects of micro-mainframe technologies.

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VI CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. M-M IS STILL EVOLVING

- What emerges from INPUT's continuing review of micro-mainframe issues and technologies is that products are maturing, but they are often limited to linking with existing mainframe software and communications utilities. This is not a problem for the user of these elements, but for others, M-M implementation often requires customized solutions or large-scale revision of entire existing systems.

- Most solutions now available are far from universal. They require coding by IS, vendors, or consultants to adapt packages to specific teleprocessing environments.

- Universal solutions are elusive because of the various file structures, communications protocols, and data formats developed over many years now residing on mainframes.

2. THE PROBLEMS ARE NOT INSURMOUNTABLE

- M-M benefits to an organization can be substantial.

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- End-user computing, mated to micro-mainframe applications, can effectively reduce the IS applications backlog by giving end users the power to build models, extract data, and manipulate information into the form desired on a more timely basis.

- An effectively configured network will find more utilization in a productive M-M environment and, thus, becomes more of a corporate asset.

- M-M implementation can bring problems caused by misunderstandings and by the need to plan for the effects of M-M usage on communications, processing, and memory storage capacity.

- The problems raised by M-M are not insurmountable.

  - Security, for example, can be addressed in IS terms, with passwords, file access authorization, audit trails, call-backs, and encryption.

  - Network capacity planning can be assisted by using available computerized tools, by staged implementation while considering each application's demand on resources, and by planning accordingly.

  - Communications costs of M-M are embedded in the overall corporate network expenses. Justification can often be based on productivity improvements and on the enhanced utility of the corporate network.

- The tools are available to begin implementing M-M and to gain the experience to determine how M-M can be productively used to help manage corporate information. Prototype and pilot implementations provide valuable experiences and a chance to evaluate the impact of M-M on the corporate network in controlled, noncritical environments.

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3. IMPACT ON THE NETWORK MUST BE ANALYZED

- The effects of telecommunications technology developments work to confuse informed analysis of the issues. It is difficult to determine how to specifically implement these technologies to fit unique corporate needs. M-M adds another level of complexity.

- Communications planning for M-M is often treated as an afterthought. This may be excusable since M-M is a new technology and the methods for determining its network impact are not very advanced.

- Nevertheless, planning is necessary, applying the techniques suggested below in order to insure that the corporate network is properly managed to accommodate all communications increases.

B. MICRO-MAINFRAME PLANNING METHODOLOGY

- The general steps recommended in planning implementation are:

  - Study requirements.

  - Evaluate costs.

  - Consider other alternatives, such as file servers or remote computing services as a interim step.

    . RCS timesharing bureaus offer software to link to their mainframes, permitting data downloading for end-user manipulation.

    . This M-M experience, prior to in-house implementation, provides time to evaluate internal needs and available options.

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- Proceed slowly on implementation.

I. A BEGINNING, DEPARTMENTAL LEVEL APPROACH

- IS should identify a cooperative user area that:
  - Uses a significant number of standalone micros.
  - Currently rekeys corporate data.
  - Uses data from a software product that has proprietary downloading.
- IS should verify that the department is interested and committed to downloading data. This can be an important political factor since it is an indication of probable success.
- Next, IS should:
  - Measure departmental output in terms of the number of records or reports processed to determine the current level of productivity. This will serve as a benchmark for demonstrating the tangible benefits of M-M.
  - Analyze the data needed.
  - Establish implementation and conversion schedules. It may be desirable to overlap the M-M application with current methods.
  - Provide extract files of needed data.
  - Set up inquiry and/or scheduled downloading, possibly through the information center or staff assigned to that function.

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- IS and the Telecom managers need to anticipate the department's connectivity needs, and they also need to anticipate the impact of M-M on current network users.

  - Response time may be affected by interactive M-M applications.

  - Scheduled file transfers may affect other batch users of the network.

- This is accomplished by providing additional dial-up lines, installing required cable, adding communications controllers, or otherwise making adjustments to accommodate the implementation.

- Forecasting and then measuring the actual communication changes driven by M-M will provide important guidelines for future planning.

- Throughout the implementation steps, IS should carefully explain what is and is not currently possible using this approach.

- This approach is a good start for M-M development in a controlled environment. It is a noncritical program which permits development of working relationships between the telecom and data processing departments within IS and with end users. With successful implementations behind it, any caution IS shows toward more ambitious and technically demanding M-M projects will be better accepted.

2. AN ON-LINE BATCH STRATEGY--IMPLEMENTING PRODUCTION SYSTEMS

- On-line batch systems are those where micros perform processing, with the micro and mainframe occassionally exchanging data. They require less linkage holding time but higher speed communications for the typically large files which are exchanged.

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- IS departments developing on-line batch systems for production environments must steer a carefully developed course.

  - Micros must be sufficiently isolated from the host so input and output can be viewed essentially as file transfers.

    . This is true even if data transfers are short and frequent, such as transactions.

    . Such isolation has ramifications for network design decisions.

    . If micros are too isolated, central control and coordination can be weakened.

  - This closes the gap between micro processing recognized as host transactions and other data base changes not normally host system transactions.

- The key micro-mainframe planning steps are shown in Exhibit VI-1.

3. IMPLEMENTING INTERACTIVE APPLICATIONS

- Interactive applications are the riskiest to implement due to their complexity, demands on processing, and the measures needed to insure accuracy.

- Interactive systems based on terminals are, of course, operational. However, the desirability of adding micro level processing needs to be evaluated.

  - If real time data is needed, then direct mainframe connections are required.

  - Communications demands of micros functioning interactively are the same as required for interactive terminals. The implementation is

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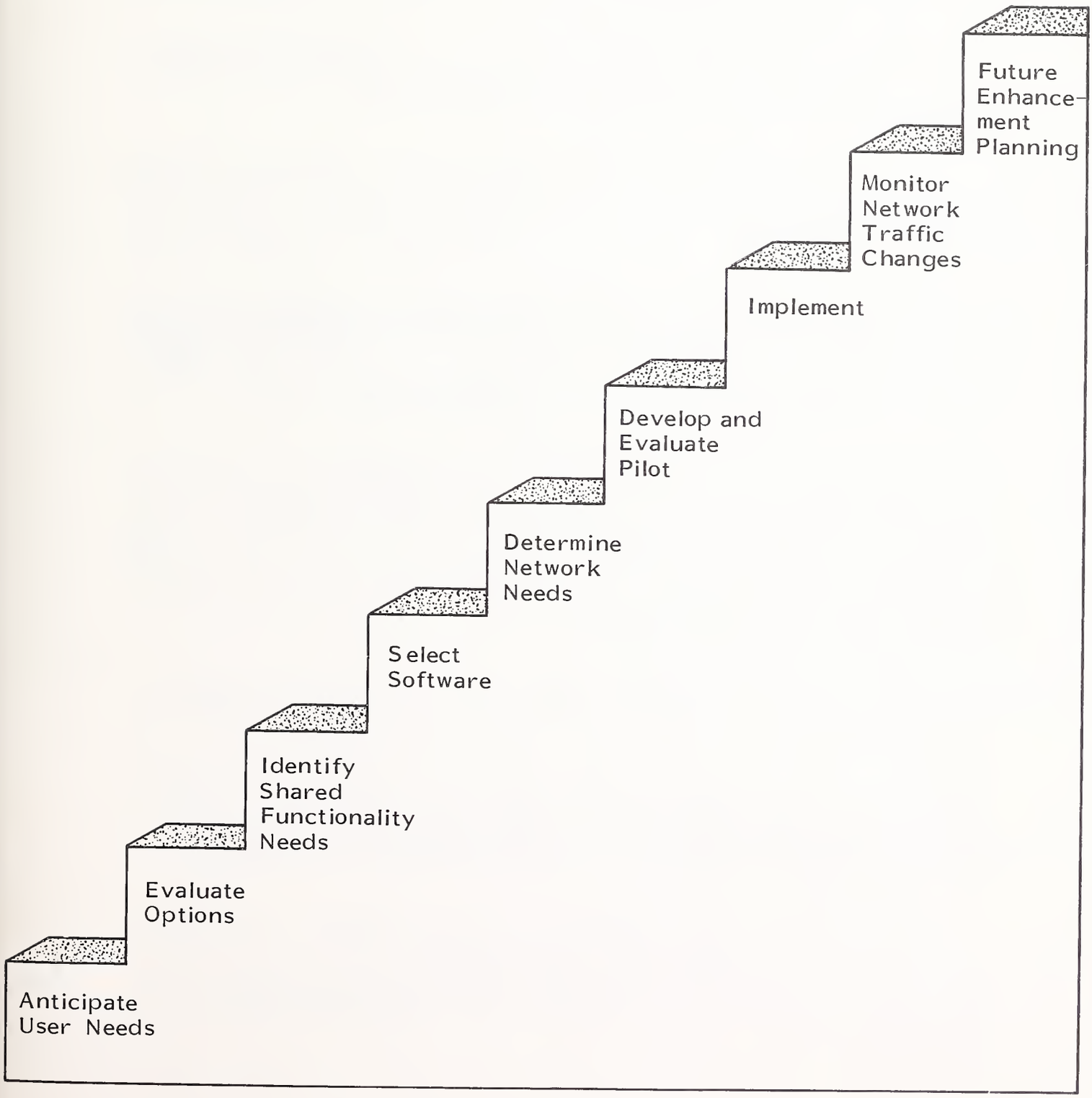
EXHIBIT VI-1

MICRO-MAINFRAME PLANNING STEPS



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more costly than terminals, due to higher micro costs and the need for link products (i.e., boards and software).

- The addition of micro processing adds a complication, perhaps without clear benefits. However, if the end user requires micro applications as well as interactive mainframe access, then the combination of functions would be cost effective.

- IS should require end users to justify requests for the highest, most complex, and costly M-M configurations for interactive applications.

C. FOCUS ON THE GOAL

- IS needs to evaluate requests for M-M applications and question the assumption that advanced, two-way data flows to and from the mainframe without the safety of intermediate processors are really necessary.

- INPUT believes that current attention on micro-mainframe is really focusing on an intermediate step, and that many existing products are likewise interim solutions to the problem of making information available to those who need it. Interim solutions, including those developed in-house, may be needed in the absence of satisfactory products.

- The current focus of M-M is to meet end-user demands, thus benefiting personal productivity directly and corporate information management indirectly. This bottom-up approach needs to be validated by top-down corporate planning and recognition that M-M can serve corporate needs. IS and Telecom need a more proactive, rather than reactive, strategy.

- IS and the Telecom manager should not lose sight of their central goal of meeting current and future information demands and the optimization of corporate facilities for the productive and competitive benefit of the corporation.

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APPENDIX A

MICRO - MAINFRAME USER QUESTIONNAIRE

1. With 1 representing "disagreement" and 5 representing "agreement", to what extent do you agree that "within five years most applications that are now host-based will have a considerable amount of funtionality taken over by personal computers that are linked to the host."? Why?

_____

_____

2. INPUT is defining "on-line batch" micro-to-mainframe linkages as those linkages where the micro performs processing on a standalone basis and, periodically, the micro and the host exchange data. The host may then futher process the data received.

   Given this definition, do you believe that links between host computers and micros will be predominately interactive, predominately on-line batch, or about the same?

   _____ Predominately interactive

   _____ Predominately on-line batch

   _____ About the same

   Why? _____

   _____

3. a. With 1 representing extreme centralization and 5 representing extreme decentralization, how would you rate your information systems function?

      _____

   b. With 1 representing "no impact" and 5 representing "great impact", how would you rate the impact of micro-to-mainframe applications on moving a company like yours toward a more decentralized information systems function?

      _____

      Why? _____

      _____

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4. a. With 1 representing "no assistance" and 5 representing "much assistance", how much assistance do you expect to be able to get from vendors in helping to plan and implement your organization's critical micro-to-mainframe applications? _____

b. More specifically, how would you rate: (1-5 with 5 good)

VENDOR TYPE	RATING
IBM	_____
Microcomputer hardware vendors	_____
Software vendors who primarily offer mainframe software	_____
Software vendor who primarily offer micro software	_____
Remote processing (timesharing) vendors (e.g., McAuto, Boeing)	_____
Turnkey systems vendors	_____
Professional services and consulting firms	_____

Next, I am going to describe several approaches for contructing micro-to mainframe applications and I would like you to rate each on a 1 to 5 scale with 1 representing "not common" and 5 representing "very common".

5. The first approach I would like you to rate concerns . . .

a. . . .modifications of existing applications systems.

1.) How common do you think modifications of this type will be done solely by the vendor? _____

2.) How common do you think modifications of this type will be done solely by in-house information systems staff _____

3.) How common do you think modifications of this type will be done jointly by vendors and in-house information systems staff _____

b. . . . writing new applications that use existing and data base(s):

1.) How common do you think modifications of this type will be done solely by the vendor? _____

2.) How common do you think modifications of this type will be done solely by in-house information systems staff? _____

3.) How common do you think modifications of this type will be done jointly be vendors and in-house information systems staff? _____

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5. Finally, I would like you to rate the approach that concerns. . .

   c. . . .writing new applications that use new files and data base(s):

      1.) How common do you think modifications of this type will be done solely by the vendor? _____

      2.) How common do you think modifications of this type will be done solely by in-house information systems staff? _____

      3.) How common do you think modifications of this type will be done jointly by vendors and in-house information systems staff? _____

6. a. For your own organization, what specific applications do you see as being the most suitable as micro-to-mainframe applications? (They need not be computerized applications now.) (Use work space below.)

   b. Are these applications planned and if so, at what stage are you implementing them? (Planning stages: no concrete plans, planning, applications being developed, applications already implemented.)

   c. Do you expect to develop these applications in-house, purchase an existing package from an outside vendor, or modify in-house an existing package?

		STAGE:				SOURCE:		
CODE	APPLICATION NAME	NONE	PLAN	DEVL.	IMPL.	IN-HOUSE	VENDOR	BOTH
_____	1. _____	___	_____	___	_____	_____	_____	_____
_____	2. _____	___	_____	___	_____	_____	_____	_____
_____	3. _____	___	_____	___	_____	_____	_____	_____
_____	4. _____	___	_____	___	_____	_____	_____	_____
_____	5. _____	___	_____	___	_____	_____	_____	_____

Comments:

1. _____
2. _____
3. _____
4. _____
5. _____

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7. a. In order of importance, with the first being the most important, what do you consider to be the top three problems solved or alleviated by micro-to-mainframe systems?

CODE

1. _____ _____

2. _____ _____

3. _____ _____

b. In order of importance, with 1 being the most important, what do you consider to be the top three problems caused by micro-to-mainfram systems?

1. _____ _____

2. _____ _____

3. _____ _____

c. What can your organization do to solve each of these problems?

1. _____ _____

2. _____ _____

3. _____ _____

d. What can vendors do to solve each of these problems?

1. _____ _____

2. _____ _____

3. _____ _____

On a scale of 1 to 5, with 1 = low importance and 5 = high importance, How important will it be for . . .

8. a. . . . your company's micros to be connected with mainframes within your company? _____. Why this rating? _____

_____

What type of communications linkage would you most likely use for this situation?

_____ Local Area Network _____ Dial up

_____ Leased Lines _____ Public Data Network _____ WATS

_____ Other _____

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8. b. . . . the same micro to link to more than one brand of mainframe at different times? _____. Why this rating? _____

_____

What type of communications linkage would you most likely use for this situation?

_____ Local Area Network _____ Dial up

_____ Leased Lines _____ Public Data Network _____ WATS

_____ Other _____

How important will it be for . . .

c. . . . your company's micros to be connected with micros in other departments? _____. Why this rating? _____

_____

What type of communications linkage would you most likely use for this situation?

_____ Local Area Network _____ Dial up

_____ Leased Lines _____ Public Data Network _____ WATS

_____ Other _____

d. . . . your company's micros to be connected with mainframes in other companies? (e.g., subsidiaries', suppliers', or customers') _____.

Why this rating? _____

_____

What type of communications linkage would you most likely use for this situation?

_____ Local Area Network _____ Dial up

_____ Leased Lines _____ Public Data Network _____ WATS

_____ Other _____

e. How important will it be for your company's mainframe to be connected with micros outside of your company? _____. Why this Rating? _____

_____

What type of communications linkage would you most likely use for this situation?

_____ Local Area Network _____ Dial up

_____ Leased Lines _____ Public Data Network _____ WATS

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9. a. What telecommunications operating system(s) do you have?

_____ TSO _____ CMS _____ CICS _____ IMS DC

Others: _____

b. Which of these will require micro links by 1987?

_____ TSO _____ CMS _____ CICS _____ IMS DC

Others: _____

10. a. What data base management systems do you have?

_____ IMS _____ IDMS _____ ADABAS _____ TOTAL

Others: _____

b. Which of these will require micro links by 1987?

_____ IMS _____ IDMS _____ ADABAS _____ TOTAL

Others: _____

11. a. Do you expect microcomputer use in your company to accelerate the use of mainframe-based relational data base management systems in your company? _____ YES _____ NO (If NO, skip to next number)

b. Which one(s)? _____ DB2 _____ MDBS III _____ BASIS

Others: _____

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12. a. Do you expect microcomputer use in your company to _____ Increase _____ have no effect on _____ Deacrease your mainframe processing requirement by 1987?

As a percentage of your current mainframe processing capacity, what percentage change do you expect in mainframe processing demand to result from microcomputer use by 1987? _____%

b. Do you expect microcomputer use in your company to _____ Increase _____ Have no effect on _____ Decrease your mainframe disk storage requirement by 1987?

As a percentage of your current mainframe disk storage capacity, what percentage change do you expect in mainframe disk storage demand to result from microcomputer use by 1987? _____%

(For Number 13, 13a. should equal the sum of 13b, 13c, and 13d)

	NUMBER INSTALLED NOW	NUMBER BY 1987
13. a. How many micros do you have total in your company now? 1987?	_____	_____
b. How many of these are used as standalone units now? 1987?	_____	_____
1) How many Local Area Networks do you have now? 1987?	_____	_____
2) How many of these LANs have communication links to a mainframe or minicomputer now? 1987?	_____	_____
c. How many of your micros are used in Local Area Networks now? 1987?	_____	_____
d. Excluding those micros used in LANs, how many of your micros are connected to a mainframe or minicomputer now? 1987?	_____	_____

14. Of all your micros which are connected to the mainframe, about what percent are used solely for terminal emulation now? 1987?

_____% Now _____% 1987

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15. Of all your micros, about what percent are in use by computer professionals versus "end-users"?

    I.S. Professionals _____% + End Users _____% = 100%

16. a. Do you have any multiuser microcomputer systems? _____ YES _____ NO (if no ask for 1987)

    b. How many multiuser microcomputer systems (e.g., AT, Altos) do you now have installed? How many do you expect to have installed by 1987?

    Now _____ 1987 _____

    c. How many multiuser microcomputer systems have communications links to a mainframe or minicomputer? How do you expect will have links by 1987?

    Now _____ 1987 _____

17. On a scale of 1 to 5 with 1 = "Low importance" and 5 = "High importance", how important do you see UNIX-based systems being to your organization's plans? _____ Why? _____

    _____

    _____

THANK YOU

Interviewer: (Rate the interviewww's disposition as a source for additional information on the topic of micro-to-mainframe)

_____ Very informative

_____ Informative

_____ Not very informative

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APPENDIX B

MICRO - MAINFRAME VENDOR QUESTIONNAIRE

Name: _____

Company: _____

Address: _____

Title: _____

1. How would you define the micro-mainframe market? _____

_____

2. How large is it? 1984 dollar growth rate? _____

_____

WHERE DO YOU FIT?

3. What micro-mainframe products do you currently offer? _____

_____

4. What are their prices? _____

5. Future products? _____

_____

6. What was your total company revenue in 1984? _____

7. What was your revenue from micro-mainframe products? _____

8. How many units of _____ did you ship? _____

9. What percent of your micro-mainframe sales are direct versus through retail or other channels? Will this change, if so how? _____

_____

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COMPETITION

10. Who are your top three competitors in the micro-mainframe market?

11. Can you estimate 1984 market share? Units or expenditure installed base?

12. Who will be most successful in the near future? Why?

STRATEGIC ISSUES

13. Key issues and trends in the micro-mainframe market?

14. Is support an issue? Why?

15. Has your company developed alliances with other firms to develop or market micro-mainframe software? Who? In the future?

16. Will data interchange standards emerge? If so, how will they impact the micro-mainframe market?

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17. What will IBM do in the micro-mainframe market? Will they be a threat to you?

_____

_____

18. Bundling links as part of standard mainframe or micro package? _____

_____

19. Generic links versus specialized mainframe data base vendor link?

_____

_____

20. Any new opportunities you see in the market? _____

_____

Comments: _____

_____

_____

Name of someone in product technical support? _____

_____

THANK YOU

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APPENDIX C: CORPORATE RESPONDENT PROFILE

- The 129 corporate respondents were in the following industrial sectors:
  - Discrete manufacturing: 9.
  - Processing manufacturing: 15.
  - Transportation: 7.
  - Medical: 4.
  - Services: 8.
  - Distribution: 16.
  - Utilities: 3.
  - Banking: 28.
  - Insurance: 4.
  - Federal government: 7.

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- State and local government: 23.

- Other: 5.

- Small corporations (i.e., revenues under $250 million) accounted for 42 of the respondents.

- Mid-sized companies (i.e., revenues between $250 million and $1 billion) accounted for 31 of the respondents.

- Large companies (i.e., revenues over $1 billion) accounted for 42 of the respondents.

- The balance (14) were unrecorded.

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About INPUT

INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, and office products and services.

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Formed in 1974, INPUT has become a leading international planning services firm. Clients include over 100 of the world's largest and most technically advanced companies.

Offices

NORTH AMERICA

Headquarters
1943 Landings Drive
Mountain View, CA
94043
(415) 960-3990
Telex 171407

Detroit
220 East Huron
Suite 209
Ann Arbor, MI 48104
(313) 971-0667

New York
Park 80 Plaza West-1
Saddle Brook, NJ 07662
(201) 368-9471
Telex 134630

Washington, D.C.
11820 Parklawn Drive
Suite 201
Rockville, MD 20852
(301) 231-7350

EUROPE

United Kingdom
INPUT, Ltd.
41 Dover Street
London W1X 3RB
England
01-493-9335
Telex 27113

France
La Nacelle
Procedure d'abonnement 1-74
2, rue Campagne Premiere
75014 Paris
France
322.56.46
Telex 220064 X5533

Italy
Nomos Sistema SRL
20127 Milano
Via Soperga 36
Italy
Milan 284-2850
Telex 310352

Sweden
Athena Konsult AB
Box 22232
S-104 22 Stockholm
Sweden
08-542025
Telex 17041

ASIA

Japan
ODS Corporation
Dai-ni Kuyo Bldg.
5-10-2, Minami-Aoyama
Minato-ku,
Tokyo 107
Japan
(03) 400-7090
Telex 26487

Singapore
Cyberware Consultants (PTE) Ltd.
2902 Pangkor
Ardmore Park
Singapore 1025
734-8142

INPUT®
Planning Services For Management

INPUT®
1943 Landings Drive, Mountain View, CA 94043, (415) 960-39